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POWER AND GAS
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ELECTRIC CONDUIT SYSTEM OF THE PANAMA-PACIFIC INTERNATIONAL EXPOSITION

BY HENRY BOSCH, JR.[1]

The grounds of the Panama-Pacific International Exposition comprise 625 acres in the Harbor View section of San Francisco, occupying a natural amphitheatre overlooking San Francisco Bay and its Golden Gate entrance from the Pacific. These grounds include part of the United States military reservations, the Presidio at one end and Fort Mason at the other. They extend over two miles on the water front and are one-half mile wide.

lessons instead of words what mankind is and does, and seeks to do in 1915.

The Concessions Section will contain the amusement features of the Exposition and will provide entertainment in its every sense and form. This section is in the eastern portion of the grounds, convenient to the heart of San Francisco.

The slope of this natural site is uniform, the highest ground lying in the east wing. There is a

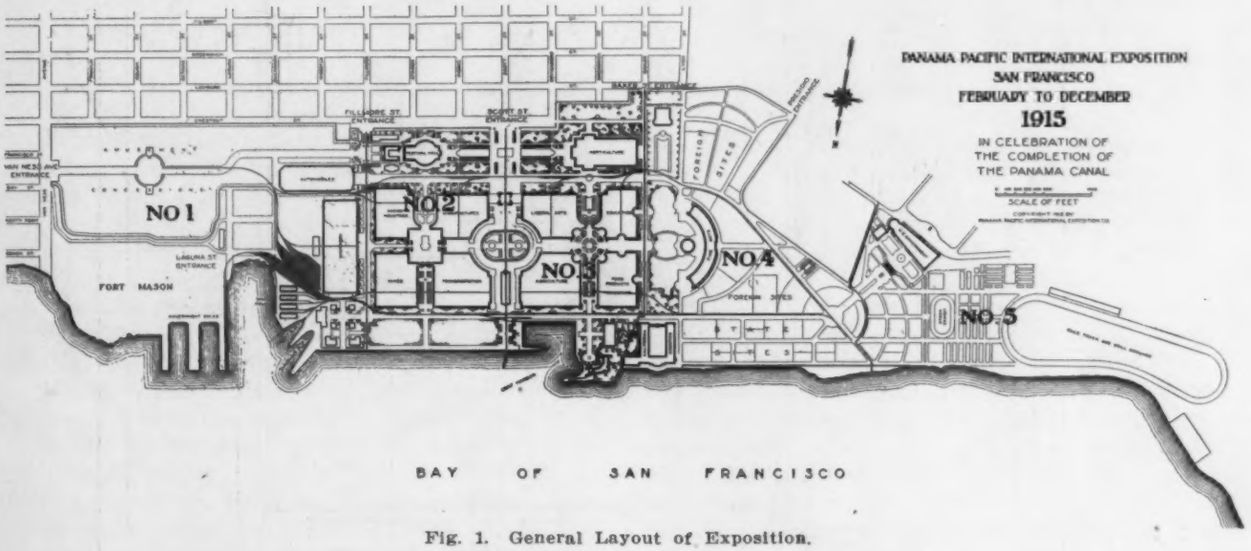

Fig. 1. General Layout of Exposition.

The site is divided into three parts: National, State and Foreign Sites; Exhibit Buildings Section, and the Concession Section.

The National, State and Foreign Sites section, located in the Presidio, will be devoted to diplomatic, state and social functions.

In the center or Exhibit Buildings section will be located the exhibit palaces. These structures will be grouped about courts and so connected that visitors may traverse all without passing from under cover. Here will be found the exhibits brought from all parts of the world to tell the student and thinker by object

difference of about 70 ft. between this ground and the average elevation found in the south gardens. The Exhibit Buildings section occupies the center basin and has a change of grade of about 12 ft. in its slope from the south gardens to the north esplanade.

To prepare the grounds many buildings had to be disposed of, some by wrecking and others carried bodily to other foundations prepared to receive them outside the grounds. Much of the low ground was brought to grade by means of dredgers. A fill of 1,600,000 cu. yds. was made in this manner. The soil consists mainly of beach sand, and a water table will be found within four feet of certain finished grades in that section to the extreme north and west.

[1]Chief Draftsman Mech.—Elect. Dept.

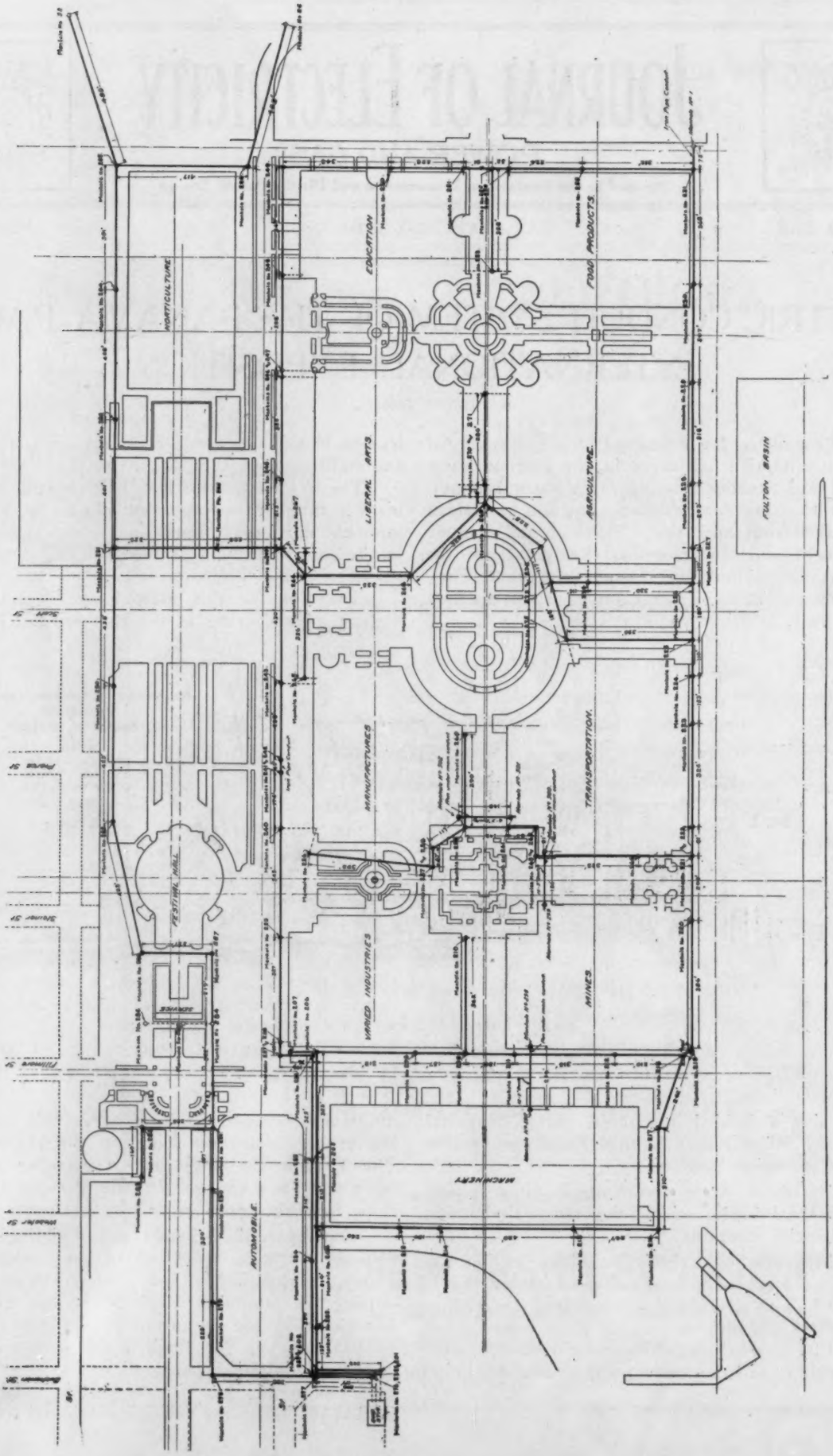

Fig. 2. Conduit Layout for Exhibit Building Section.

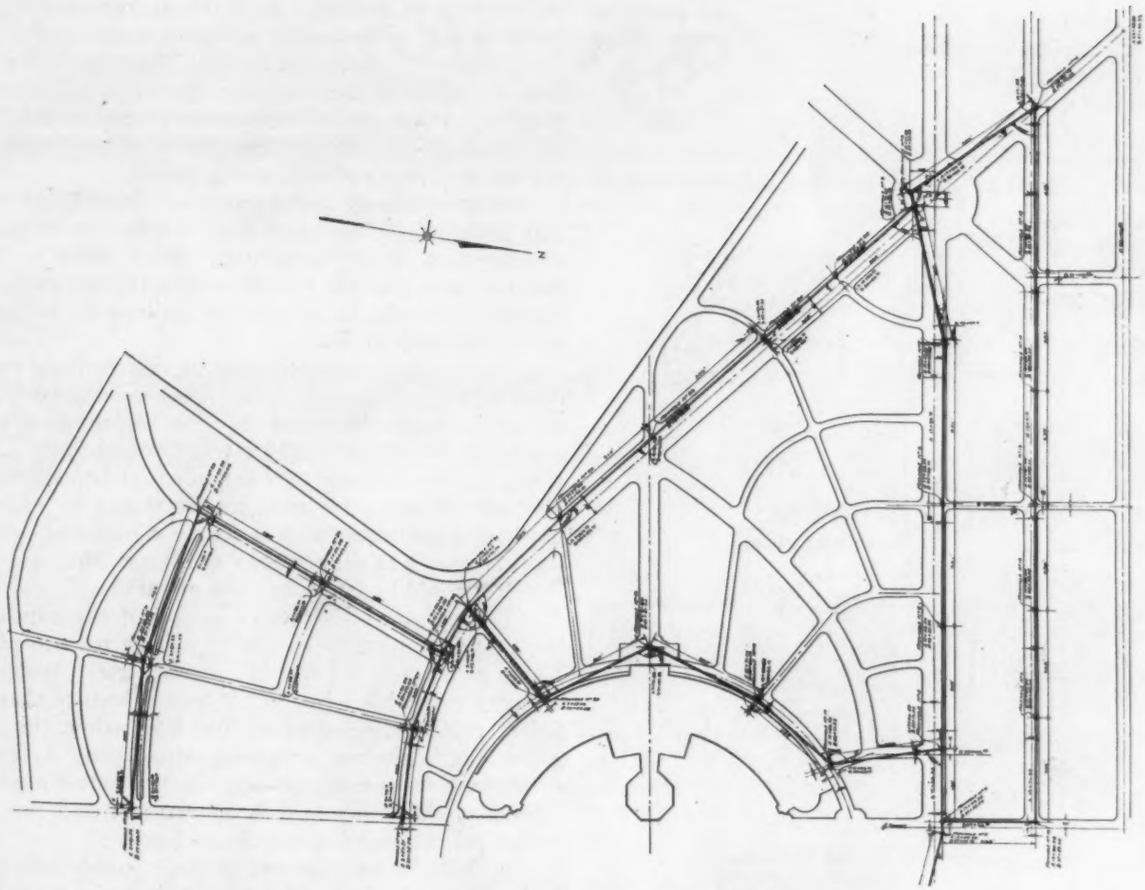

Fig. 3. Conduit Layout for National, State and Foreign Section.

First class drainage will be provided by means of a carefully planned sewer system installed by the exposition company. These sewers will tap standard city sewers, with the exception of the drainage system installed in the Presidio grounds. This will be lifted from a specially constructed sump and pumped into the bay by means of motor-driven centrifugal pumps. This installation will have a capacity of 6,000,000 gallons per 24 hours.

Unlike other expositions, the period of time elapsing between the opening and the closing of the gates will extend over ten months, opening on the 20th day of February, 1915, and closing on the 4th day of December of the same year, making it a winter to winter event. During this entire period electric service will be furnished to all parts of the grounds. This service will be maintained through underground conductors, with minor exceptions, and it is the purpose of this article to describe the electric conduit installation involved.

To distribute electric energy economically, avoid unsightly construction, maintain good service, and keep the whole in accord with the temporary construction expected of such an event, left the designers to face the problem—How shall it be installed?

A general study of the grounds showed that with few exceptions, all of the exhibit buildings are grouped in close proximity, and the Concessions Section reasonably close, the most remote section lying in the Presidio.

From an economical point of view the general scheme of the exposition as a whole seemed to have been laid out most carefully with consideration to distribution of electric energy. The point at which energy could be fed into the system with greatest convenience to the central station furnishing this energy, happens to be the logical point with reference to the load. Automatically as the feeder lengths increase, their loads decrease.

Referring to Fig. 1, and commencing at the extreme east, we have, as the general layout shows, the Concessions Section with an area of about 45 acres, which it is assumed will require approximately 2500 kw. Adjacent to this section follows the Exhibit Buildings Section with approximately 3,500,000 sq. ft. of exhibit area, as well as the main entrances, spectacular lighting effects, towers, etc., the day load being assumed at practically 4500 kw., which it is expected will shift to decorative lighting and effects after the closing hour of the exhibit buildings.

The States and Foreign Sites Section lies well to the west, consisting of approximately 100 acres, not including that area devoted to stock exhibits, race course, etc. The government exhibit will be located in this section; 2500 kw. is assumed a fair requirement for this section.

With a main source of feed for the system located between the Concessions and Exhibit Buildings Section all feeders are reasonably short, the load being within easy range except the lengthy runs to the

States and Foreign Sites. A study of the possible load expected indicated a probable peak of 12,000 kw. when motor, light and grounds lighting overlap during dark periods.

It might be of interest to add that the loads assumed for the Exhibit Buildings and Concession Section were not made on the basis of requirements of

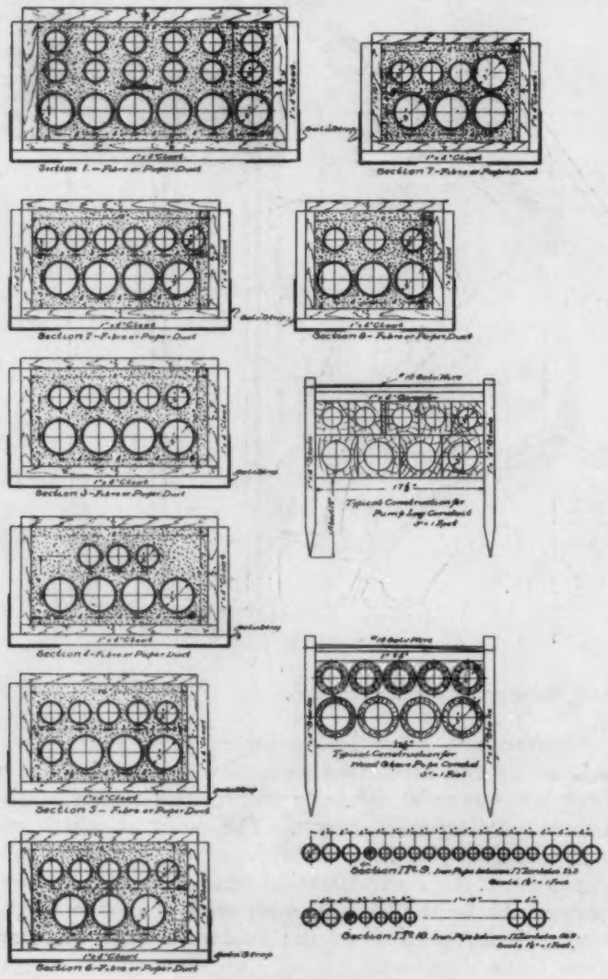

Fig. 4. Typical Conduit Cross-Sections.

past expositions, owing to the recent introduction of the tungsten lamp and other devices perfected since the occurrence of an exposition of equal magnitude.

The load for the States and Foreign Sites Section was based on a proportionate part of total ground area being allotted to buildings, allowing one watt per square foot of building area.

After due consideration it was decided that the primary distribution system should be 3-phase, 4150 volts a.c. with grounded neutral. Direct current at 250/125 volts three-wire will also be distributed to certain of the exhibit buildings, but its distribution will not be considered at this time.

The general architectural and landscape scheme does not lend itself to electric distribution being placed where it might be visible. To traverse the roofs of buildings with 4000 volts left chance of hazard to buildings as well as human life. The headroom beneath the main floors of buildings is insufficient for the racking of feeders. In a few instances the main floors in part rest directly on the ground.

To avoid flooding or trouble from excessive surface water, since the drainage system is close to the ground surface, the transformers themselves will be placed above ground level. Subway transformers will not be used if possible to avoid them.

With overhead construction eliminated, the problem remained—How should all conductors be placed underground in an installation which must be inexpensive, safe, flexible, permit sectionalizing, and, most important of all, to permit the pulling in and withdrawal of cable at will?

With a well designed conduit system little capital need be tied up in cable lying idle awaiting such time as service might be required. The advantage in using a conduit system of such description and more particularly for the purpose here intended, prompted its use. The use of armored cable in preference to standard paper and lead cable was seriously considered. While its first cost was higher than the latter, the ease with which it could be laid was quite attractive.

During the constructive period of the exposition the grounds, literally speaking, will be torn to pieces. Little protection beyond the armor itself would be afforded the cable. Further it would require that sufficient cable be installed at that time when the landscape engineers are preparing their beds to ensure their work from being molested after once completed. This prompts a heavy first investment and one that brings no revenue for months to come.

A fault in an armored cable is quite difficult to find. The making of splices are tedious, and a serious factor is its low salvage value. The cost of resurrecting is high and the general use not as common with power companies as paper and lead cable.

With the fact in mind that a conduit system permits the drawing of cable at will, the distribution system was planned, and to insure the utmost isolation, the "grounds" were divided into three sections, namely, Concessions, Exhibit Buildings, and States and Foreign Sites.

Figs. 2 and 3 show the general layout of the system. This layout is capable of routing by means of emergency tie cable, any available power, and transferring it to another section. As an instance—power intended for the States and Foreign Sites Section may be diverted through an emergency tie and used to feed the north or south feeders of the Exhibit Section, or vice versa. The cable known as the gate cable may be tied in with either the North, South, States and Foreign Sites Section, or into an emergency feeder of the Concessions Section. This will permit the highest efficiency of installed cable. Copper may be shifted (electrically) with load as occasion might require.

In selecting a suitable conduit system, Valentine, Pump Log, Paper Duct, Wood Fibre Duct and Vitrified Clay Duct were considered. Figs. 4 and 5 show typical cross sections and various alternates called for in advertising for bids. The opening of bids decided that wood fibre duct should be adopted. These figures show the method that will be used in installing wood fibre duct. This box or trough construction will extend between manholes, and varies in dimen-

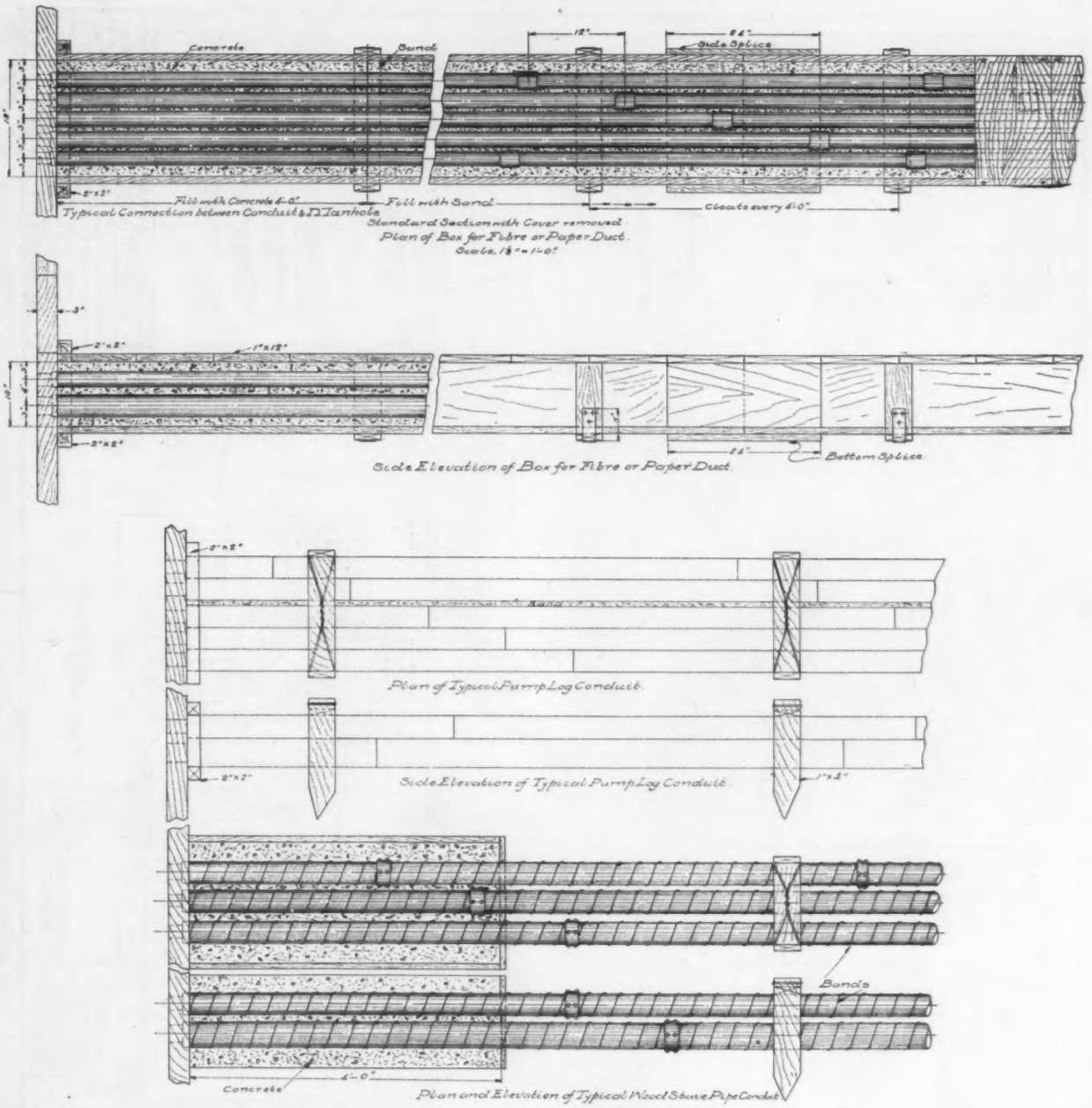
Concrete
Sand
Side Splice
Fill with Concrete 4'-0"
Fill with Sand
Cleats every 4'-0"
Typical Connection between Conduit & Manhole
Standard Section with Cover removed
Plan of Box for Fibre or Paper Duct.
Scale, 1½" = 1'-0"
Side Elevation of Box for Fibre or Paper Duct.
Bottom Splice
Plan of Typical Pump Log Conduit.
Side Elevation of Typical Pump Log Conduit.
Bands
Concrete
4'-0"
Plan and Elevation of Typical Wood Stave Pipe Conduit

Fig. 5. Typical Conduit Section.

sions to suit the amount of duct required for any particular run. The duct will be aligned by filling this box with sand.

At the point of entrance to manholes the side planking will be bored and counterbored to receive the duct and the box will be filled with concrete for a distance of 4 ft. from each manhole, using gravel or screenings to permit ease of pouring. This box or trough will be covered with planking, well nailed and running across the short dimension of the box. The bottom boards will be reinforced by means of splice plates and tied together with corner straps of sheet metal.

Iron pipe will be used where it is required to cross over existing interferences, such as sewers and water pipes. In several instances these obstructions lie within 18 in. of the finished surface.

Concessions Section.

In the Concessions Section to date there is contemplated approximately 1300 trench feet of conduit consisting of 6500 duct feet of 2 in., and 5200 duct feet of 3 in. wood fibre duct. These ducts are encased in wood construction as described above, in sections ranging from three each of 2 and 3 in. duct to twelve 2 in. and six 3 in.

This conduit will be placed at an average depth of 2 ft. 8 in. from the bottom of box to surface of finished road, or 2 ft. 4 in. to center of lowest duct.

Exhibit Buildings Section.

Approximately 25,000 trench feet of conduit will be required for the Exhibit Buildings Section, consisting of 281,000 duct feet of 3 in. wood fibre duct and 1700 duct feet of 3 in. black iron pipe. Of this amount

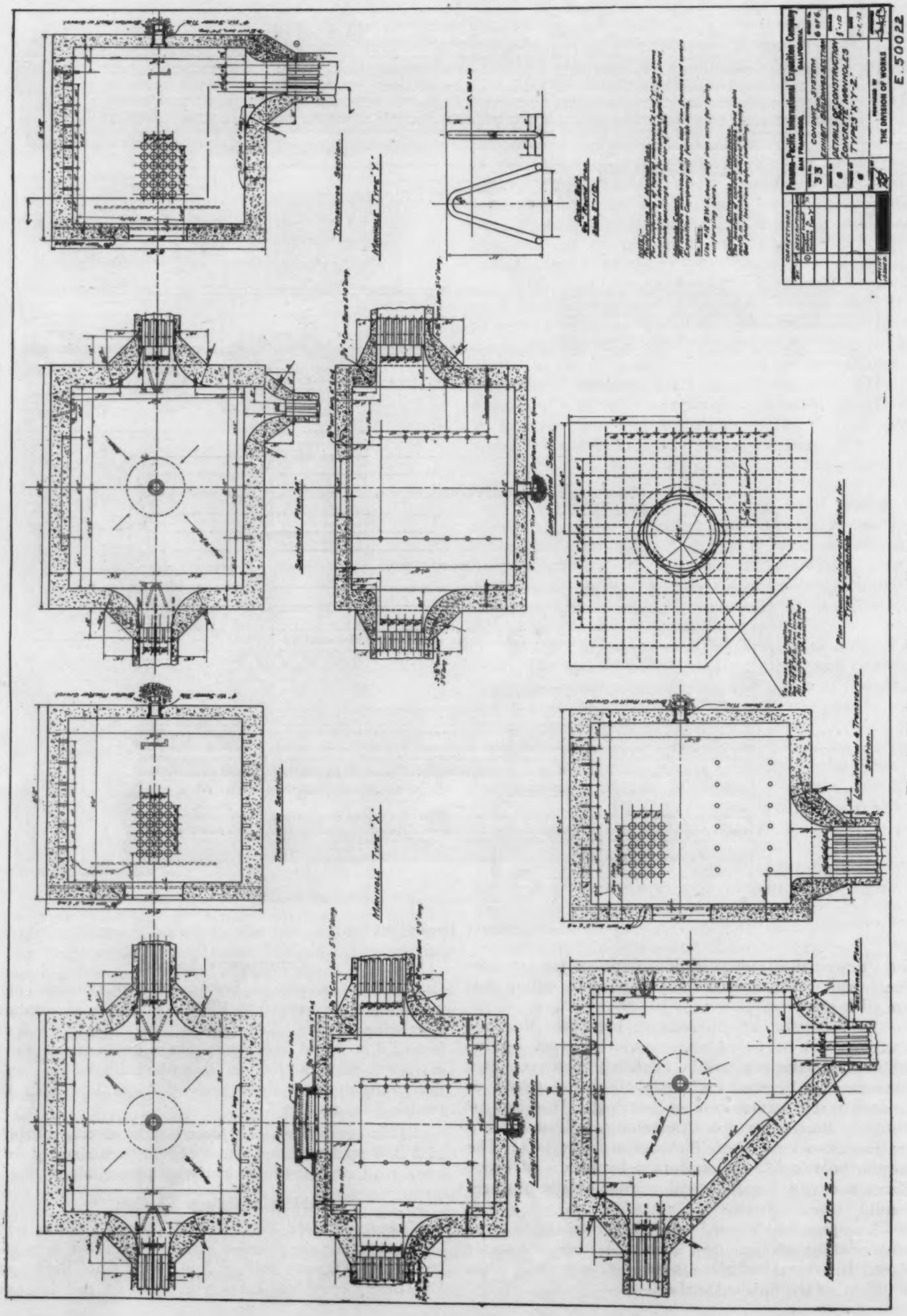

Fig. 6. Design for Concrete Manhole.

of conduit, 2700 conduit feet, or 59,300 duct feet will be laid in standard concrete construction; the remainder, excepting the iron pipe, will be installed in the adopted box construction.

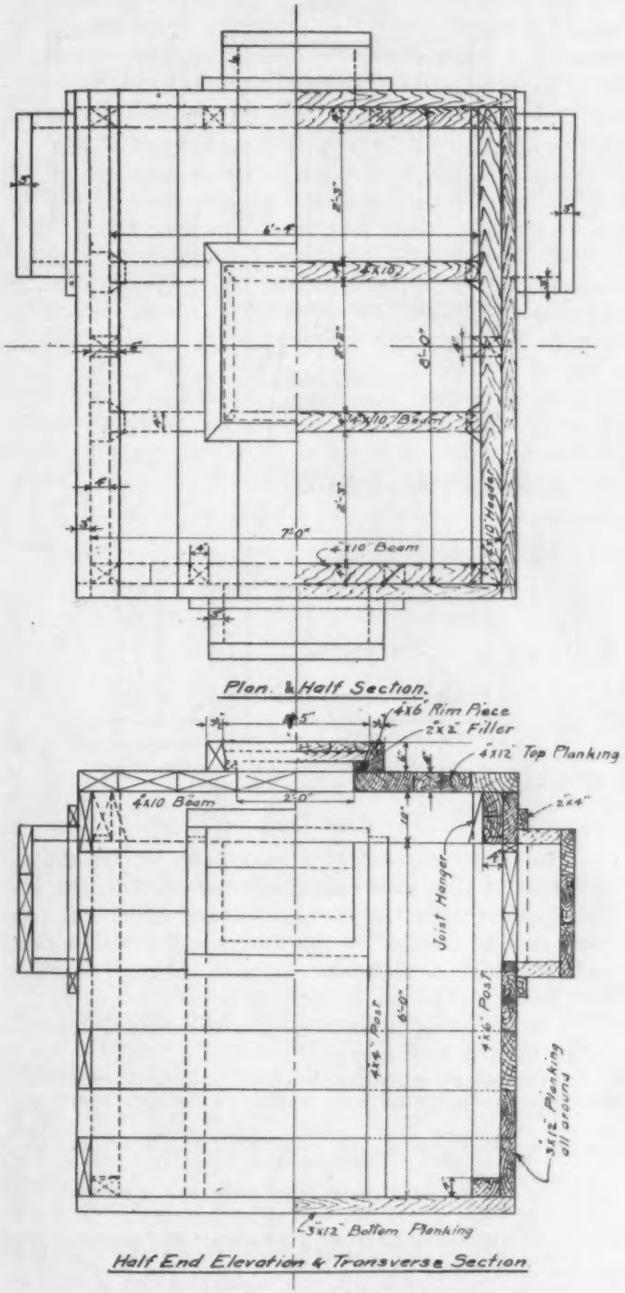

Fig. 7. Design for Wooden Manhole.

The average depth of the concrete construction will be 4 ft. 3 in. from the center of lowest duct to surface of finished road.

The wood construction will run about 2 ft. 8 in.

The cross section of this conduit installation will run from 4 wide 3 high to 4 wide 6 high in the concrete construction and from 2 wide 2 high to 7 wide 3 high in the wood construction.

States and Foreign Sites Section.

There will be 10,000 trench feet of conduit in this section composed of 2 in. and 3 in. wood fibre duct with ⅛ in. walls and slip sleeves. It will require approximately 41,000 duct feet of 2 in. and 31,000 duct feet of 3 in. duct. The average section will be 3 ducts wide and 2 ducts high. This duct will be protected by installing it in the wood box construction already described.

Manholes—Type and Design.

In the general system there will be approximately 150 manholes. Thirteen of this number will be of standard concrete construction with cast iron covers. The remainder will be of wood construction.

The concrete manholes will be built in three different types—straightaway, corner, and tee, the sizes varying from 7 x 7 x 7 ft. to 8 x 8 x 7 ft. These holes are designed for heavy duty, both mechanically as well as electrically. They will be located in that section of the

Typical Wooden Manhole.

system near the power house and exposed to severe traffic conditions, being adjacent to the Palace of Machinery and the railroad yards.

Owing to the amount of duct leading into the power station, twenty-four duct was decided the limiting feature of any one conduit run. This type of hole will conveniently accommodate this amount of duct or cable. The design of these manholes is shown in Fig. 6.

The type of manholes used in the Concessions and Exhibit Buildings Section is shown in Fig. 7. There are five different types of this construction varying in size from 5 x 6 ft. to 7 x 8 ft. and from 5 to 6 ft. deep, being designed for a concentrated load of 6000 lbs. The entrance will have an opening 24 x 26 in. and the cover is so designed that the lower plank of same will positively place itself as designed when replaced.

Shaped as they are it will be impossible for covers to drop into manholes—a very desirable feature. Lifting ears are provided which will facilitate their removal.

In the States and Foreign Sites Section, manholes of shallow construction will be required due to the depth at which standing water is to be found. Fig. 8 shows this type of design. To avoid encountering the water table all manholes in this section will be but 4 ft. deep. The minimum dimensions of a manhole in which electrical conductors are placed and men

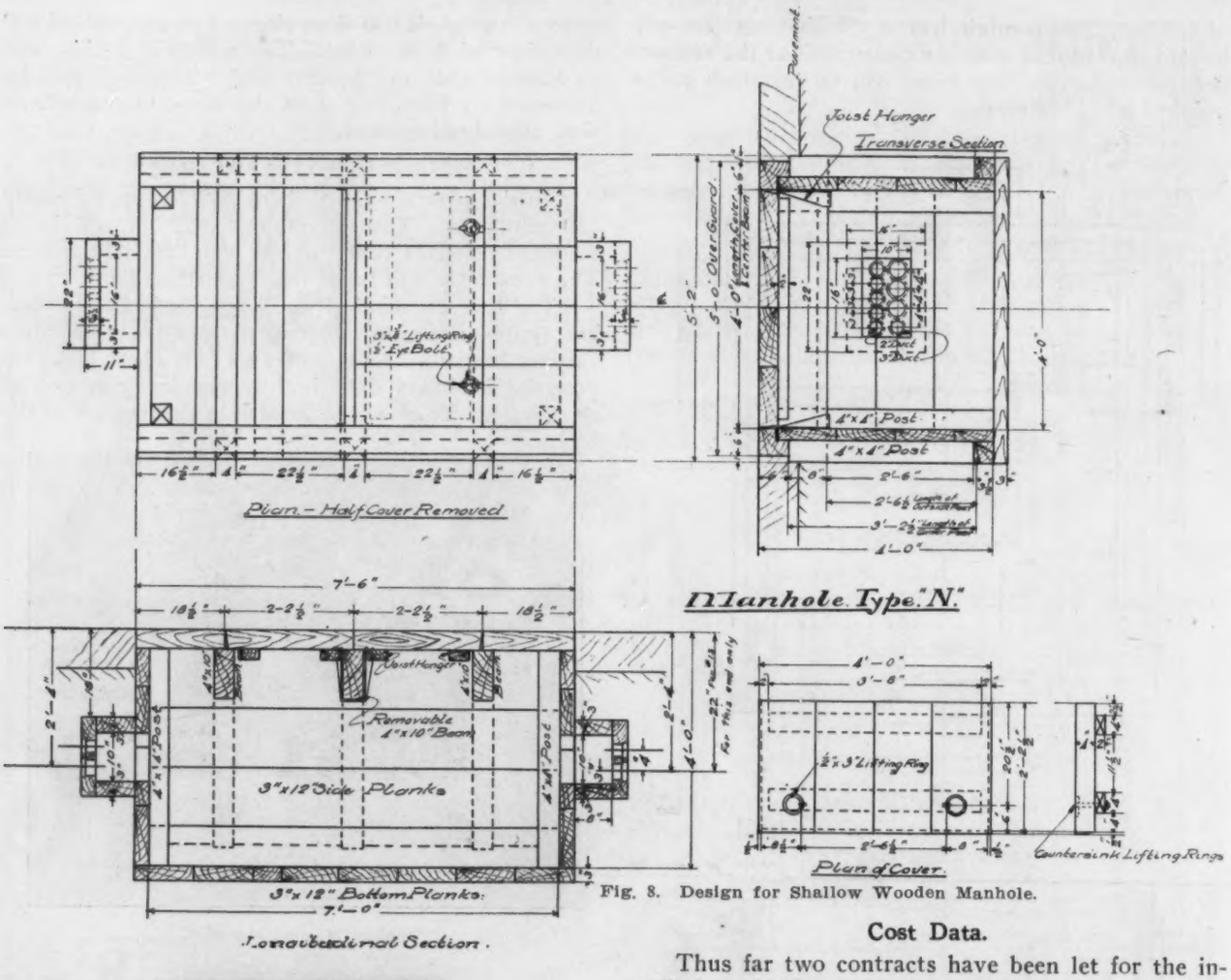

Fig. 8. Design for Shallow Wooden Manhole.

Fibre Duct Conduit Construction.

compelled to work, as set by law, must be 4 x 4 ft. in the clear with 5 ft. clear head room.

These manholes will vary in size from 4 ft. x 4 ft. 6 in. to 6 x 8 ft. and have an entrance 4 ft. square in the clear. The covers will be made in two pieces, supported by a removable center beam. By the removal of this 4 ft. cover these shallow holes will meet the requirements of the law.

Not only will this conduit system provide facilities for primary cable, but also for all arc cable trunks as well as the private telephone and signal system of the exposition.

Cost Data.

Thus far two contracts have been let for the installation of this work, all conduit located in the Exhibit Buildings Section being awarded under one contract, and all conduit in the States and Foreign Sites Section under a separate contract. Actual work is now being carried on in both sections.

The following unit costs are the actual contract prices quoted and accepted:

EXHIBIT BUILDINGS SECTION—CONDUIT.

Installing 3 in. inside diameter wood fibre duct in standard concrete construction; conduit section 12 to 24 ducts, at 11c per duct foot.

Installing 3 in. inside diameter wood fibre duct in adopted wood box construction; conduit section 18 to 21 ducts, at 8.65c per duct foot.

Installing 3 in. inside diameter wood fibre duct in adopted wood box construction; conduit section 10 to 15 ducts, at 9.91c per duct foot.

Installing 3 in. inside diameter wood fibre duct in adopted wood box constructions; conduit section 4 to 8 ducts, at 12.33c per duct foot.

The average cost for installing 3 in. wood fibre duct in wood box construction is 10.3c per duct foot.

EXHIBIT BUILDINGS SECTION—MANHOLES.

Manholes of timber construction ranging in size from 5 x 6 ft. and 5 ft. deep at $36 each, to 7 x 8 ft. and 6 ft. deep at $65 each. Average, $49.30 each in place.

Manholes of concrete construction ranging in size from 7 x 7 ft. and 7 feet deep to 8 x 8 ft. and 7 ft. deep average $129.30 each in place, exclusive of cast iron cover which is furnished by the Exposition Company.

STATES AND FOREIGN SITES SECTION—CONDUIT.

Installing twelve 2 in. and six 3 in. inside diameter wood fibre duct in wood box construction, at $1.47 per conduit foot.

Installing six 2 in. and three 3 in. inside diameter wood fibre duct in wood box construction, at $0.93 per conduit foot.

Installing three 4 in. and three 2 in. inside diameter wood fibre duct in wood box construction, at $0.76½ per conduit foot.

The average cost, in place, for installing 3 in. wood fibre duct ranging in sections as given above, is $0.10.3 per duct foot.

STATES AND FOREIGN SITES SECTION—MANHOLES.

The actual prices of the shallow type of wooden manholes used in this section range from $20 to $27 each, and average $25 each in place.

MULTIPLEX TELEGRAPHY AND TELEPHONY

BY W. R. BIRT.[1]

During these times when so much is being said about economy, efficiency and conservation of various forms of energy, it might not be amiss to consider some of the ways that savings may be effected in the telegraph department of a railroad.

Railroads generally have long lines of copper multiplex telegraph circuits extending from their general offices to their many divisional headquarters. These circuits are used exclusively for the movement of long haul commercial and executive business of the railroad company. The message load they are expected to protect rarely exceeds the capacity of a polar duplex circuit. On a railroad having 6000 miles of operated road, this class of circuits is frequently in excess of 3000 miles. The cost of line construction of such circuits, based on the cost of wire, insulators, pins, tie-wires, sleeves and labor, is $38.79 per mile. Assuming a 50-year life, a net scrap value of $21.30 per mile, maintenance $1.00 per mile, taxes at one per cent, interest at 6 per cent, and $2,00 per mile for taking down, would cause an annual charge of $4.06 per mile to be assessed against these circuits. The utilization of this existing plant when equipping divisions with telephonic train dispatching and message circuits will make possible a saving of from $116,000 to $135,000.

The telephone train dispatching circuit as usually constructed is composed of No. 9 B. & S. gauge hard drawn copper wire. The average length of a train dispatching circuit is 130 miles. In the valley and desert districts the separation between telegraph offices is between 12 and 15 miles; while in the mountain districts, the separation is generally between 5 and 6 miles. The requirements, therefore, are that this circuit shall have a transmissional margin sufficient to admit of from 10 to 22 way-stations simultaneously listening in on the line.

The selective calling equipment now generally employed on these circuits is of the electro-mechanical step-by-step type of selective relay, the essential features of which are a combination wheel and a time wheel, suitably governed by magnet, levers and detents. Just as a combination lock will open only to its own setting, so the selector can be operated only by impulses of a predetermined number and sequence. The combination wheel differs in its teeth cutting in every selector on a circuit, and while the calling impulse sent over the wire actuates every selector, yet it will not go to the contact position and operate to call an office unless its individual combination is made. The selector is wound to 4500 ohms and is connected with the proper taper resistance so as to produce equal current in all bridges.

Automatic calling is accomplished by the use of keys in the dispatcher's cabinet, that have a simple train of gears operating a circuit breaker. The calling may also be done by Morse key sending over the line a predetermined number of impulses of current, properly spaced between each group of impulses.

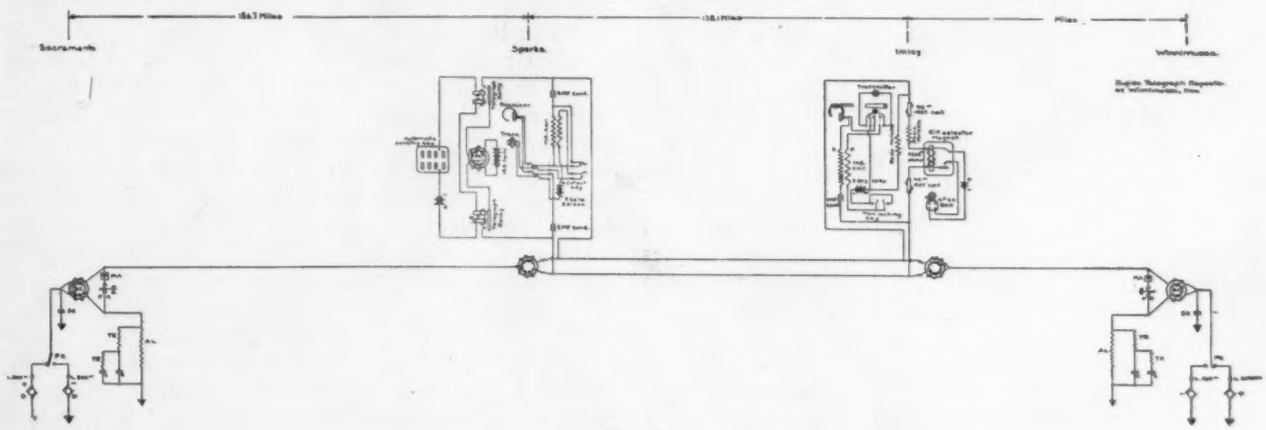

Fig. 1.

The receiver circuit on the best type of railway telephone equipment developed for this class of service has an impedance of 2500 ohms, therefore each receiver that is off of its hook occasions a transmission loss of approximately one cable mile for offices beyond that are receiving from the dispatcher.

In Fig. 1 is shown a typical telephone train dispatching circuit which is in operation over the fourth district of the main line of the Southern Pacific Company's Salt Lake Division, between Sparks, Nevada, and Imlay, Nevada, a distance of 138.1 miles, and over which an Overland multiplex telegraph circuit is being regularly superimposed. The impedance bridges caring for the telegraph circuit at each terminal of the dispatching circuit have an impedance of 29,800 ohms to a frequency of 1000 p.p.s., so therefore occasion a telephonic transmission loss to the dispatching circuit of less than one-tenth of a cable mile each. As the transmission over 30 miles of standard cable is regarded as the commercial limit, it is customary to express the transmission equivalent of any other kind of line as that length which gives the same volume of sound as 30 miles of standard cable. The attenuation of this cable at 800 p.p.s. is 0.103, and that for No. 9 B. & S. gauge hard drawn copper wire is .00652,

[1]Paper presented before San Francisco Section, A. I. E. E., May 23, 1913.

therefore the length to which speech is commercial over this type of circuit becomes

$$L = \frac{0.103 \times 30}{.00652} = 474 \text{ miles.}$$

As this dispatching circuit is but 138.1 miles in length the line transmission loss at 15.8 miles of wire to one mile of cable, is 8.7 miles of cable, and that occasioned by the telegraph impedance bridges is .2 of a cable mile, there remains an equivalent in transmission of 21.1 cable miles for the way station equipment. There are 31 way station telephone instruments on this line, 12 of which are located at telegraph offices, the balance are in booths at the non-telegraph passing tracks, the possibility, therefore, of more than 21 of these way stations having the receiver simultaneously across the line is quite remote.

The first distinct advantage of the telephone, and one that is noticeable as soon as a circuit is placed in service, is the time saved in calling offices for the purpose of putting out orders. An operator having outside duties, such as delivery of freight, baggage or express, etc., has his attention immediately called to the fact that he is wanted by the ringing of the bell, while by telegraph he is called until he happens to come within earshot of the telegraph instrument; in the meantime, even though only five minutes may have elapsed, this may have made the combination the dispatcher had in mind valueless, and the set back this train received may result in its having a number of bad delays before reaching its terminal. In telegraphic train dispatching, the dispatcher copies the order in his book as it is first repeated; while in telephone dispatching, the order is written in his book as it is transmitted to the interested stations, thus making possible its repetition at about the rate of ordinary conversation, or in approximately one-fourth the time required to repeat it by telegraph.

The train movement which is being protected by the telephone dispatching circuit on the fourth district is perhaps the heaviest on the Salt Lake Division. In addition to having all of the overland passenger and freight trains for a distance of 138.1 miles, the Tonopah trains, the Fallon Branch, the Wadsworth branch and the Fernley-Lassen branch trains are all handled over this district for a distance of about forty miles; besides this the double tracking operations on the east end of the district require that innumerable work train movements against opposing trains be arranged for. The chief dispatcher remarked that between October 5th and November 1st the traffic became so great on this district that had it not been for the telephone dispatching circuit the district would have had to have been divided and an additional set of dispatchers put on to properly handle the traffic. The consensus of opinion, however, is that a telephone dispatching circuit increases the efficiency of the train dispatcher about 25 per cent. Although this train dispatching circuit is on a telegraph lead carrying 17 other telegraph circuits, the interruptions have been very few. Since the circuit was placed in service on September 4, 1912, there have been but four instances where the telegraph had to be resorted to to protect the train movement, and then only for a very few hours. Three interruptions were due to other wires breaking and fouling the dispatching pair, and the fourth was caused by a mica burning through and grounding the circuit in the lightning arrester at a non-telgraphic office.

The telegraph circuit over this dispatching circuit is carrying between 350 and 500 messages during the office hour period daily, and apparently is as capable of speedy operation with semi-automatic transmitting keys as are those circuits containing no artificial inductance. The transmitting key referred to is used perhaps by four-fifths of the operators of this country. It consists of a vibrating rod or pendulum which when moved to one side by the operator makes a dash, and when moved to the other side automatically vibrates—until stopped by the operator—in the act of so doing making any desired number of dots. It is estimated that sixty per cent more movements are required in sending by the ordinary Morse key than by this device.

The repeating of this circuit at Sacramento has not imposed any noticeable burden upon the repeater attendant at that point, for he is still able to handle nearly 300 messages and perform all of the repeater attendance required during his nine hours of service.

The impedance bridges now in use for the telegraph circuit have a d.c. resistance of 1500 ohms, and it is found that this value does not give the dispatcher a "bat" in the ear when selectively calling a station. On a dispatching circuit 150 miles in length, such bridges together with the joint resistance of the paralleled wires make possible a telegraphic conductor having an ohmic resistance of 1,063½ ohms; the operation of two such dispatching circuits in tandem in bridge duplex telegraph service would require a potential of but 156.6 volts to maintain a line current of .050 amperes. With the multiplex sets poled in conjunction this voltage will develop a working current of 100 milliamperes in the main line, which is the amount used in practice. The increased leakage conductance due to the paralleled wires, however, suggests the use of the third potential (240 volts) on such circuits. The voltages that are standard in telegraph work and which are generally obtainable at the division terminals of a railroad are 160, 240 and 350; the last named potential frequently has a value of 320 volts. The coil lag due to the impedance bridges may be compensated for by placing an equivalent inductance in the artificial line of the multiplex apparatus. In the case of but one telephone dispatching circuit in the telegraph circuit it has not been found necessary to so compensate the artificial line of the multiplex equipment.

Telegraph departments have within themselves other opportunities for economic gains, because, fundamentally, two simple telegraph circuits are wasting one telephonic possibility. Therefore, the primary reason for repeating at Sacramento the circuit shown in Fig. 1, was in order that its telephonic possibilities between Sacramento and San Francisco might be taken advantage of. In Fig. 2 it is shown as the companion wire to the San Francisco-Portland multiplex circuit in a composite telephone circuit between the p.b.x's. at Sacramento and San Francisco. To make this talking circuit commercially quiet through the numerous serial telegraph cables in the city of San Francisco, the submarines and undergrounds, core

strands in even conductor cables were assigned for its reception. With a view to silencing the effect of the Morse signals on the telephone receiver, a differentially connected coil is placed in series with each limb of the talking circuit and the telegraph side connected to the ground through a 6 to 10 microfarad condenser. A pair of conductively connected coils with the middle point grounded are bridged across the talking circuit for the purpose of removing the cross-fire between the telegraph circuits and lessening the noise on the talking circuit.

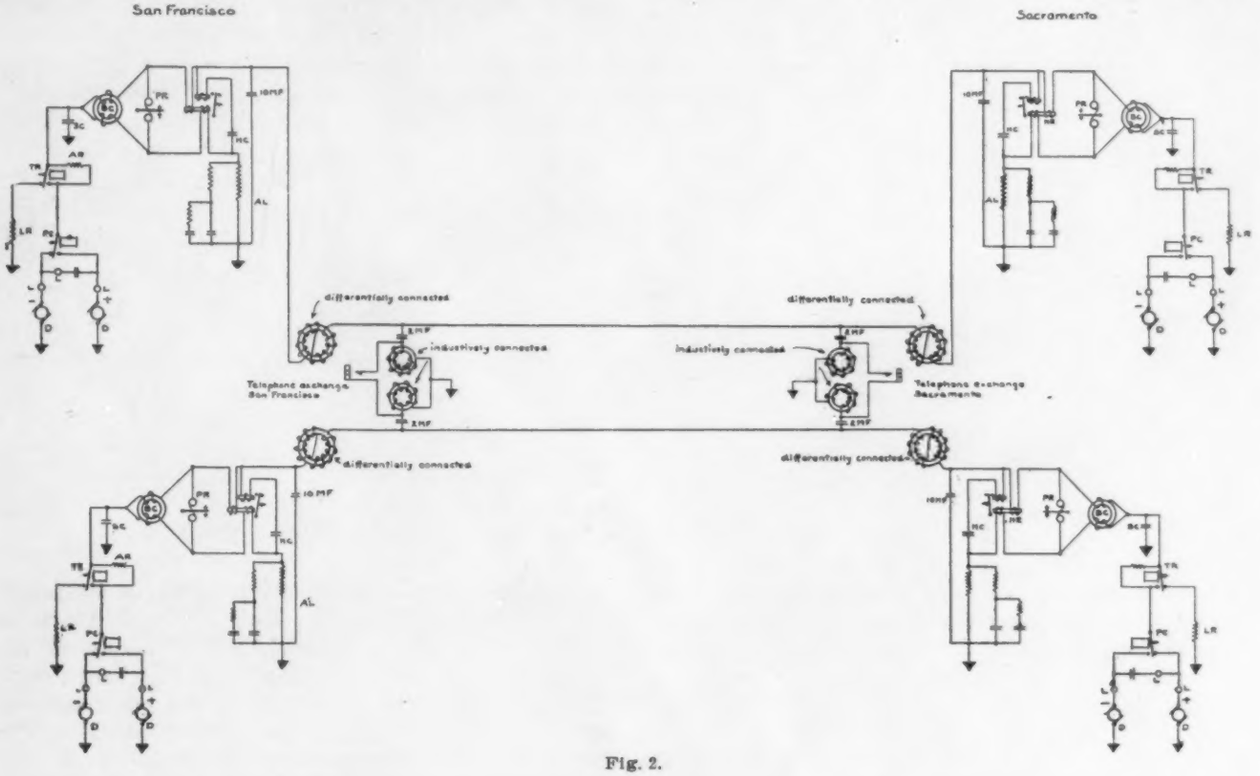

Fig. 2.

The bridge type multiplex apparatus is very efficiently operated over circuits of the composite type; one of the greatest advantages claimed for it being in the arrangement of the bridge coils. Instead of being ordinary non-inductive resistances as in the old type of bridge multiplex apparatus, there are two 500 ohm coils wound upon a ring shaped core of soft iron wires. The theory of which is that because of its closed magnetic circuit, this coil offers great impedance to any current passing through it from one end terminal to the other; consequently, a current coming in over the main line wire at first meets with considerable opposition in its attempt to flow through the bridge coil, and as a result almost all incoming current rushes into the polar relay. This effect lasts only for a small fraction of a second, during which time the opposition to the current in the bridge coil gradually disappears, thus allowing the currents in the various branches to reach their steady values. The brief initial rush of current through the polar relay is sufficient to pull the armature of that instrument over with a speed and precision out of all proportion to the smaller steady current passing through the relay during the remainder of the signal. It is in connection with the operation of the holding coil, which holds the neutral relay closed during the interval of no magnetism due to the current reversals of the distant pole changer, that this coil is particularly beneficial in quadruplex working, because its magnetic discharge is not only utilized to energize the holding coil, but owing to the gradual manner in which the closed core parts with its magnetism, the discharging current is lengthened out, and it is thus possible for it to act upon the neutral relay armature for a period more nearly equal to that represented by the interval of no current at the distant pole changer. Rapidity of action in the pole changer is made possible by its having two electromagnets, one on each side of the armature, and both connected in series in the local circuit. The cores of the front magnet are laminated, which make that magnet quick-acting, while solid cores, surrounded by copper sleeves, are used in the rear magnet to make it slow acting. A light retractile spring is attached to the armature to hold it on the back contact and prevent shivering when the local circuit is open. When the local circuit is closed, current flows through both of the magnets of the pole changer, but the front magnet exerts its attraction slightly in advance of the rear magnet and thus pulls up the armature to the front contact. Soon afterwards, the rear magnet becomes fully energized, but cannot pull back the armature because the latter is now much closer to the front magnet. When the local circuit is open, the magnetism in the front magnet falls away very rapidly, while that in the rear magnet dies away gradually; as a result the front magnet releases the armature while the rear magnet is still capable of pulling it back and the armature is thrown over to its back contact much more swiftly than if the retractile spring alone was depended upon for this action.

The arrangement of the apparatus heretofore used

for repeating from one multiplex set to another was that whereby the receiving relay controlled the sending transmitter through local connections, but the mechanical inertia of these instruments and the increased number of local contact points through which the operation is controlled was not conducive to high efficiency. In the center of Fig. 3 is shown two pair of direct-point duplex repeaters; it will be seen that the arriving signal from the east or south will actuate the right hand polar relay thus placing the armature of that instrument in contact with a 240-volt negative potential, which is given an outlet through the center of the bridge coil to the line west, and in a like manner signals arriving from the west are relayed to the east by a reverse operation. As the local contact points of the polar relays are now employed to deliver line currents, special devices are provided to control the local circuits for operating reading sounders. When the direct-point repeater was first introduced the polar relays were equipped with double armatures, mechanically jointed together, but electrically separated, one contact controlling the line potentials, and the other the local circuit. The later day practice is to use the leak arrangement whereby a single tap is taken off of the armature of each polar relay and led to the ground through an adjustable 15,000 or 20,000 ohm rheostat. Another method of accomplishing the same result is to substitute a 0.5 mf. condenser for the leak coil, thus obtaining the same response in the polar relay without any loss of current through the leak coil to the ground. The facility of operation, therefore, of the present type of multiplex repeaters contributes in no small measure towards removing the limitations formerly placed on the permissable number of multiplex repeaters in a circuit.

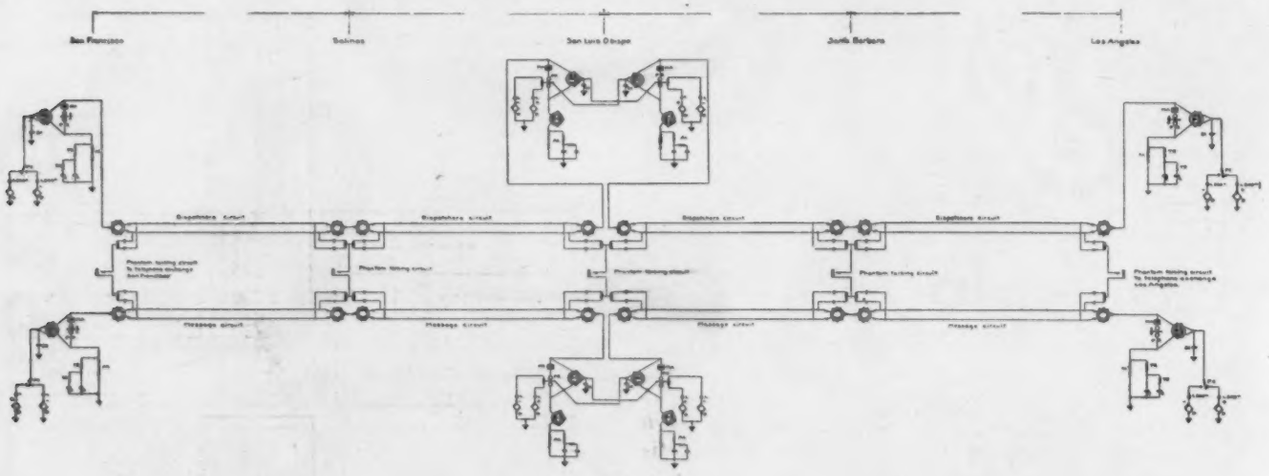

Fig. 3

Upon the completion of a dispatching circuit over a busy division, there is usually a demand for a like message circuit. When a division has both a dispatching and message circuit in service, it is obvious that the wires may be used not only for local station-to-station dispatching and message purposes, but for two through multiplex telegraph circuits and a phantom talking circuit as well.

Within 60 days, 63 per cent of the main line of the coast division will have been completely equipped for telephone train dispatching service. Upon its final completion, it is expected that the circuits will be arranged as shown in Fig. 3. The phantom talking circuit thus obtained being carried to the telephone exchanges at San Francisco and Los Angeles.

The coast line route is about 473 miles and is an all open wire lead, and as the commercial limit of the physicals upon which the phantom is to be built is 474 miles, it is expected that with the 10 to 14 per cent increased transmission possible with phantom circuits, that the repeating coil losses will be sufficiently overcome so as to make possible acceptable speech transmission between the locals off of the two exchanges.

As the plant economy fully justifies the placing of additional repeaters in long haul message circuits so as to admit of their use in divisional telephone service, the superintendent of telegraph of the Southern Pacific Company is arranging his outside wire plant so as to admit of the use of all existing copper multiplex telegraph circuits in simplex, composite and phantom telephone service as well.

SUCCESSFUL ENGINEERING OPERATION AT LAKE SPAULDING.

Now that snow has receded to the higher reaches in the Sierras, work on the new Lake Spaulding dam is again well under way. This dam which is being built by the Pacific Gas & Electric Company below the outlet of Lake Spaulding to increase the storage capacity of that lake more than 15 times, and which will be the highest dam in the world will form a part of the 165,000 horsepower development for that company which is well under way. The dam will have a gravity section and will be a solid concrete structure which will contain about 300,000 cu. yds. of concrete. Two Portland cement companies in California are working night and day to supply the cement necessary for this work and the amount of rock necessary which is being quarried out of the cliffs immediately above the dam is necessarily enormous.

In order to obtain large plumb stones a tunnel was driven into the cliff above the dam site and this was loaded with two charges of high explosive under the direction of an expert powder operator, the object being to bring down at once enough rock for construc-

tion work. The blast which was let off last week was successful and loosened even more rock than it had been calculated would be dislodged. At the time the South Yuba River was unusually high and the rock piling into the bed of the river caused the water to flow over the top of the concrete work already in place. A derrick was also displaced by the force of the blast.

Reports emanating from some unknown source that an accident had occurred, damaging the dam, were erroneous, as the blast was only a part of this work which is of great magnitude. For a short time the water flow caused the cessation of the work of pouring concrete in the dam, but this was resumed the following day. Work is progressing very rapidly and the company expect that by December, when it will be neecssary to cease work for the winter, that the dam will be practically completed.

THE ECONOMIC STATUS OF THE STREET CAR SYSTEM OF SAN FRANCISCO.

BY F. K. BLUE.

There has been such a discrepancy of opinion in regard to the economic status of the street car system of San Francisco that the following study was made in an endeavor to arrive at an unbiased view of the situation based on a careful examination of the information available.

The data are taken chiefly from the report of Bion J. Arnold, to which references are made. The estimates of population and other items have been compared with other estimates worked out independently and found to be in substantial agreement.

In order to reach a comparative view of values under different circumstances, probable net earnings and the present values of such net earnings have been estimated for various assumed conditions for a period of 40 years as follows:

1. Part of the system covered by the present franchises, operated by the United Railroads with minimum betterments, as at present to yield the greatest return during the life of their franchises.

2. Part of the system covered by the present franchises operated by the United Railroads during their life, with betterments and operative improvements necessary for efficient and satisfactory service.

3. The whole system operated by a single private company with betterments and improvements necessary for efficient and satisfactory service.

4. Part of system not covered by present franchises operated by the City with betterments and improvements necessary for efficient and satisfactory service, and with wage conditions conforming to the provisions of the charter.

5. Whole system operated by the United Railroads according to Arnold's recommendation. "Plan 5," under the proposed Charter Amendment No. 34.

6. Whole system operated by the United Railroads under the self-adjusting rate fixing method.

Operation by the United Railroads for Maximum Profit.

The present value of the investment is assumed to be $28,000,000 and the present depreciated or physical value of the property is assumed at $21,000,000 as indicated in the Report of Bion J. Arnold (p. 86). This corresponds to an investment at the rate of about $110,000 per mile of single track while the present cost of extensions is about $80,000 per mile (see Report, Table 9). Since no fund has been accumulated to keep the value of the tangible assets up to the amount of the investment, the real investment has thereby been reduced to the depreciated value of $21,000,000, the remaining $7,000,000 having been liquidated by being paid to the security holders in the form of interest and dividends; and since that sum is now presumably bearing interest in some other investment, it has no right to be considered as entitled to interest as a part of the tangible assets of the property. The present value of the real cost of the investment will therefore be considered to be $21,000,000.

The additional investment in minimum betterments just sufficient to maintain the operating integrity of the property is estimated by Arnold to be about $8,000,000 (Report, p. 83.) This sum distributed

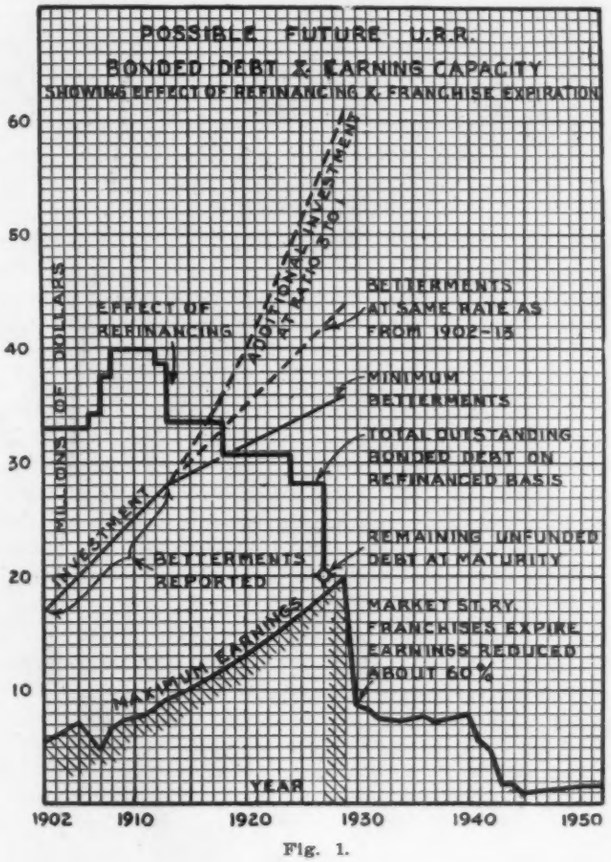

Fig. 1.

over the period as shown in Fig. 1, would be made available by the present investment of $5,060,000 at 6 per cent interest. The present value of the cost of the whole required investment is therefore $26,060,000.

In order to reduce all future incomes and expenditures to a common basis at which they are properly commensurable their present worth has been computed as of 1912 with interest at 6 per cent. This rate of interest has been taken as substantially the public estimate of the value of investment in the property, as shown by the market price of the underlying securities. Therefore the cost of future investments may be measured by the present cost of the bonds that

might be purchased now to meet such future payments, and the value of future income may be measured by the amount that might be realized at present from bonds that would amount in the future to the value of the future income.

The total probable earnings of the company are based on Table 5 of the Report, and Fig. 1, taking into account the relative mileage (p. 400) which would be operated by the United Railroads and by some other corporation or by the City, and having due regard for the relatively greater earnings per mile from the lines already established. The gross earnings of the United Railroads for the year 1929, estimated in this manner, amount to $14,100,000, while the total earnings of the whole system (as shown by Table 5 and Fig. 5) are estimated at $19,900,000. From an independent computation Arnold states that the gross earnings of the United Railroads without extensions for the year 1929 might be $15,000,000 (p. 394). After 1929 the earnings range from $7,000,000 to $1,000,000, on acount of the lapse of franchises.

As shown in Table 41 of the Report, the total operating expenses of the United Railroads, not including depreciation, are now about 60 per cent of the gross earnings, and have been decreasing for the last four years. Assuming that it would continue to take 60 per cent of the gross earnings for the operation of the property and the maintenance of its operating integrity the total net income would then be 40 per cent of the gross earnings, and for the forty year period until the last of the present franchises expires would amount to $110,000,000. At 6 per cent interest the present worth is these items of income is $53,990,000.

It is assumed that the remaining physical value of the $36,000,000 investment is liquidated from time to time during the period from 1929 to 1952 as the present franchises expire. Since no allowance has been made in this estimate for keeping the property up to a proper operating condition, it is assumed that one-fourth of its cost or $9,000,000 might be realized from it as the franchises expire. The present worth of these sums amounts to $2,350,000. The present value of all the resources of the property then amounts to $53,990,000 plus $2,350,000, which equals $56,340,000. Subtracting from this, $26,060,000, the present value of the investment required, leaves $30,280,000, which is the present value of the franchises under these conditions, and represents literally an absolutely free gift that was made by the people of San Francisco to the street car companies by the granting of the franchises, providing the board of supervisors do not or cannot secure more reasonable service or a lower fare from the United Railroads.

(To be continued.)

PROGRESS ON PANAMA CANAL.

According to present plans, Gatun Lake, now practically stationary at about 49 ft., will be allowed to fill after July 1, until it has reached its normal level of 85 ft., which event, in case there is a season of average rainfall, is expected to take place about December 1. The rise in the lake level will probably flood Culebra Cut shortly after October 1, causing a suspension of steamshovel operations near that date.

ABSTRACTS OF PAPERS PRESENTED AT THE THIRTY-SIXTH CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION AT CHICAGO, JUNE 2-6, 1913.

The following abstracts and titles of papers presented this week at the Thirty-sixth Convention of the National Electric Light Association show in a general way what is being done at the convention:

Electric Railway Loads on Central Stations.

Attention is called to the desirability of railway loads, both city and interurban, as power customers for central stations. In some of the larger cities the problem has been very thoroughly worked out and excellent results obtained by combining the requirements of the two classes of service on one generating system. There still remain, however, many opportunities for improvement in this direction, and the problem, if carefully studied, will probably disclose possibilities not heretofore considered. The growing tendency to combine various communities over large areas under one generating system will naturally tend to increase the number of cases where central stations carry the railway load. Recent improvements in transforming apparatus—notably 60-cycle rotary converters—are strong factors in the development of this business, since practically all lighting companies which have a purely light and power load are now operating on the 60-cycle basis. Typical load curves are shown indicating an improvement in load-factor as the result of combining railway load with light and power load, and also demonstrating that the central station is not burdened with an extraordinary peak as a result of the railway load. The diversity factor between railway loads and central station loads when combined on one generating system is an important consideration, since the combined loads can be carried on a generating station of much smaller total capacity than if they were separate and carried on individual stations. Furthermore, the necessary reserve capacity in the case of the combined station is also less.

Factors Producing Reliability in the Suspension Insulator.

Transmission line insulators are affected little, if any, by normal working loads, providing high maximum stresses are not set up. As the reliability of an insulator depends largely on the factor of safety, provided not for apparent loads but for the maximum stresses set up in the dielectric, it is important that true factors of safety be determined.

Two strain or dead end insulators having the same ultimate mechanical strength may have far different internal stresses for the same load. Combined stresses due to temperature and load may reach a very high value for a comparatively low working load. Since strain insulators work under comparatively low factors of safety, damage due to static puncture or partial mechanical failure will tend to show up, particularly on hot days. In some systems the lowered factors of safety on dead end insulators decreases the reliability so that a single insulator of this type may constitute a greater hazard than miles of purely suspension line. This makes their use for increased safety often questionable.

Electrical factors of safety may be increased for the unit by testing above flashing voltage. This can be done by the surge test or by oscillations set up when insulators spill with poor regulation in the testing apparatus. The use of protecting air path is the only efficient means of protecting insulators for severe surges, the reliability of the insulator increasing as the ratio dielectric strength to protecting air path increases. This protection is increased by short spacing, good distribution of stresses in series and decreased time lag in the protecting gap. The tendency is to increase the factors of safety which is most easily done with small efficient members.

Owing to the effect of mechanical strength on the design, further increase in the factors of safety must be accomplished by discharge horns, or by decreasing the protecting gap. Since the factors of safety are low at best, great care should be taken in deciding on the mechanics of the line, so as to keep down maximum stresses in order that the factors of safety may be large enough to give the desired reliability.

Transformers for Power Transmission.

The great tendency at the present time toward centralization of power is making many interesting problems on power distribution. The voltage chosen for distribution must be high enough for economical transmission and not so high that the cost of a complete substation installation makes it impractical to install those of small and moderate capacity.

The development of the outdoor transformer with the necessary switching and protective devices has made it possible to use installations of small capacity at a high voltage and at very moderate cost.

In the paper is given a curve of costs for installations of different capacity for various voltages. It shows that where the transmission lines feed a number of small commuunities, the economical voltage is 22,000 or 33,000.

It is shown that the saving by the use of an extremely small size transformer is so slight in comparison with the total cost of installation as to be negligible.

It is pointed out that there is a wide variance in characteristics demanded by the different power stations, more particularly as regards voltage variation and taps. Special emphasis is laid on the great extensions that are being made in the use of all transformers and the need of standardization as regards taps. Such standardization will result in much good to the industry at large, to the manufacturer and the customer.

Transmission Line Construction.

While the scope of this paper is not limited to any particular voltages, the matter discussed relates primarily to transmission lines carrying voltages above the 2300-volt class, and it is hoped that the outline of the author's views may result in a discussion by the meeting that will be of benefit in a discussion of the art.

In general, the construction or structural features are considered rather than the electrical or operating conditions.

It is apparent that the author considers the physical characteristics of a pole or tower line as deserving of careful attention, and that a too hasty inclusion of mechanical limitations in a specification may result either in a disproportionate expense to the industry or in transmission lines of inadequate strength.

Switchboard Instruments.

Both alternating - current and direct - current switchboard indicating meters for central-station service are described as well as new forms of alternating-current protective relays. The general features of interest common to all switchboard indicating instruments are accuracy, compactness, reliability, damping, ruggedness, accessibility and simplicity.

The sources of error or unreliability may be classified as electrical, mechanical and observational. As the electrical sources of error on the best makes of instruments are now nearly all negligible for operating purposes, the mechanical sources of erro. are of greatest importance, the principal sources being: (1) excessive weight of movement, (2) insufficient ruggedness of movement, and (3) insufficient controlling force.

Previous attempts to economize switchboard space by reducing the meter diameter were unsatisfactory because they resulted in scales of insufficient length, and other methods of economizing space by recourse to curved dials, as in edgewise meters, were likewise unsatisfactory.

The induction principle makes possible the successful-seven-inch meter, as the scale is two or three times as long as in the nine-inch meter. As the large instruments offer no advantages over these seven-inch types the latter will probably be used to greater extent in the future.

The effect of stray fields from bus-bars upon the permanency of the magnets in direct current D'Arsonval type of meters is discussed, and tests show that magnetic shielding is of no value in avoiding demagnetization when heavy short-circuits occur. A type of construction is shown in which the magnets are located so as to be practically unaffected by the stray fields.

Four different variations of a new line of alternating current induction type relays are described, giving protection against overloads and reverse currents. These relays depend for their inverse time action upon the damping effect of permanent magnets acting upon the movement disk. The overload relays can be adjusted for inverse time curves which either become instantaneous, or definite at very high overloads, thus affording means of obtaining selective protection on feeders or the lines operated in series or in parallel.

Relays located at substation terminals of transmission lines should be arranged so that tripping can never take place because of power flowing into the substation. Relays "D" completely solve the problems of reverse current protection, even in cases where voltage and power factor drop to low value during short circuits. These relays also furnish protection to ring systems of feeders, entirely clearing the line in case of ground or a short between stations.

Developments in Protective Apparatus.

Improvements in oil and carbon circuit breakers and lightning arresters due to the high voltages and

generating capacities now in general use are described in a large number of types and sizes to meet various requirements at voltages up to 165,000 and conducting capacities up to 2400 amperes.

Design and constructional improvements of oil circuit breakers include porcelain insulating pillars, clamped in position, contact details clamped thereto, use of removable separate arcing contacts, heavy steel plate tanks with lap welded points, greater volume and head of oil, and strong tank supporting details. Expansion chambers and appropriate vents are provided for the arc gases in all designs.

The floor mounting form of breaker without enclosing structure is quite popular, especially in high voltage service.

For very high capacity and voltage a breaker having self-contained reactance cut into circuit on operation of the breaker is now standard.

Carbon breakers are now made in standard capacities from 3 amperes to 24,000 amperes up to 1500 volts direct current. Modern types include the "butt" wiping form of laminated brush with metal secondary contacts and "butt" and wiping carbon final contacts. A new feature in a line of breakers for moderate conducting and breaking capacity is the use of pressed metal parts nearly throughout.

The heavy service breakers, for the higher currents and voltages have several steps of increasing resistance in shunt to the main contacts, are provided with ventilating passages between the several brush units, which also reduces the skin effect on alternating current, and use the laminated or "bus bar" form of terminal stud.

The aluminum electrolytic arrester has displaced all others for severe service. They are very rugged in design and light pipe-frame supports are used for the auxiliaries and insulating linings in the tanks. Daily charging is the usual practice and the so-called "charging resistance" is used quite generally where the surges due to charging might cause trouble. An inorganic electrolyte and the annular form of tray have demonstrated their effectiveness.

Report of the Committee on Distributing Lines.

In the discussion of distributing lines voltage is not considered as a limiting feature.

The construction especially considered is that of the Western and Pacific Coast States, since these have done most of the pioneer work in distribution. Many changes have been made in methods of transmitting and distributing electrical energy. Voltages which a short time ago were not considered commercial possibilities are today being used not only on long transmission lines but very generally for distributing purposes.

Rates are continually being reduced as the territory served increases, thus forcing operating companies to adopt a construction the cost of which will be the minimum consistent with good service.

A study of the voltages to be adopted in new territory is made and a comparison drawn between these and the demands of congested business centers. Star and delta connections, alternating and direct current, the use of batteries and of the turbine for both reserve and regulating purposes, all have attention in connection with the problem as a whole.

Types of line construction have not changed greatly during the past few years. A satisfactory way of carrying two circuits on the same line of poles is given. The use of iron wire is suggested where load is small and voltage regulation not of great importance, as in reclamation and irrigation work.

The rather severe requirements of the California Commission with regard to crossing construction are discussed. The relation of gross revenue to cost of investments in new line extensions is studied in its connection with long time contracts with customers. Sometimes the extension might be made on the basis of gross revenue for five or an even greater number of years equalling the investment. The percentage of power bills rebated averages from 20 to 25.

Report of Committee on Prime Movers.

Water Power.—Recent improvements in thrust bearing and runner design have eliminated certain objections to the vertical unit. The following subjects have received further consideration: Runner Wear and Material, Testing of Water Wheels and Forms of Stop and Relief Valves. Mention is made of two notable recent installations. The appendix contains detailed information on the principal points investigated.

Steam Power.—Developments in the Steam Turbine during the past year have been treated at some length, as well as the development in Steam Turbine-Driven Auxiliaries. The subject of Fuel Oil is treated quite completely. Various kinds of apparatus for determining the efficiency of the Steam Plant are discussed in considerable detail and special attention has been given to the Boiler House equipment.

Gas Power.—A very complete resume of the general Petroleum situation is given in the report, as well as the fluctuations in the cost of this fuel. The development of Heavy Oil Engines is treated at some length and specifications are given for suitable oil for these engines. The developments of the Humphrey Gas-Power Pump are reported upon and mention is made of the progress in development of the Gas Turbine.

A partial digest of the recent engineering publications bearing on the subject of Prime Movers and accessory apparatus, is included at the end of the report.

Report of the Committee on Measurements.

Reference is made to recent actions of various engineering societies and committees recommending the abandonment of the "horsepower" as a unit in engineering, and the substitution of the "watt" or some of its recognized decimal multiples—the "hectowatt," "kilowatt" and "myriawatt." Machines transforming power from one type to another, such as hydroelectric units or turbo-generator units, are more rationally and simply estimated as to efficiency, by rating both their input and output in the same unit. Since it is not desired by any engineers to use either "British thermal units," "boiler horsepower," or "mechanical horsepower" for their powers at both the throttle and the generator terminals of, say, turbo-generators, it is natural and desirable to express both input and output in watts.

Reference is also made to proposed recognition of the name "kelvin" in connection with a C. G. S. unit in the electrostatic system, Lord Kelvin having greatly developed both electrostatic measurements and the C. G. S. system.

The Latest Developments in Distributing Transformers.

The most important recent improvements in distributing transformers have been in relation to the materials and methods of winding and insulating the coils. This has resulted in higher factors of safety between the actual disruptive strength of the insulation and the commercial tests applied. In some cases the commercial disruptive tests have actually been increased over those formerly used, due to the greater insulation strength secured, and the qualities of ruggedness, durability and safety in operation have been correspondingly enhanced. A further result of these improvements has been to increase the operating efficiency of the transformer.

The first part of this paper discusses these superior insulating materials and the scientific method used in their application as applied particularly to the standard line of 2200-volt distributing transformers. The second part of the paper relates to the improvement in performance which these materials and processes have made possible.

The insulation of a transformer consists of three main parts: (1) between turns and layers of the winding, (2) between the high and low tension windings, (3) between the windings and the metallic parts of the transformer.

Since the insulation of a transformer is no stronger than its weakest part, its various elements must be considered in their relation to each other.

The improvements in winding and insulating discussed in the paper, in the main result from the guttered winding going with the machine type of coil, the use of improved machine formed insulating barriers and the arrangement of the oil circulating ducts. This has given lower iron and copper losses and at the same time the insulation has been improved. The improved insulation, aside from making lower iron and copper losses possible, has permitted an increase in the values of the commercial tests used.

Report of the Committee on Underground Construction

The report of the Committee on Underground Construction deals this year exclusively with high-tension transmission cables, and discusses periodic testing, the carrying capacity, graded insulation, sector conductors, current-limiting reactances, protection of cables in manholes, parallel routes, trouble reports, practical hints as to operation and specifications for paper and rubber-insulated cables for underground operating pressures in excess of 2000 volts. Considerable space is given to carrying capacity, and recommendation is made of a very decided increase in rating during the winter; also that the current rating be varied inversely with the voltage, on account of the heating in the insulation due to the leakage of current. Interest will probably be sharply aroused by the intimation that in paper cable American manufacturers are in some respects behind European, as evidenced, for example, by the bending test. In European cables the bending test is applied three times. American manufacturers consider as too severe, a test of bending, first in one direction and then in the other, twice repeated, to a radius of six times the cable diameter. The specification presented in the report increases the radius of bending to 7½ times the cable diameter. The committee hopes that the discussion of cable carrying capacity at the convention will clear up some important but obscure points.

Report of the Committee on Grounding Secondaries.

After six years of constant agitation, the committee has finally secured unanimous opinion as to the desirability of grounding secondary circuits. It has succeeded in having the National Electrical Code revised and a rule bearing upon this subject now requires the grounding of secondary circuits up to 150 volts and leaves the grounding optional above that voltage.

The committee suggests that all member companies anticipate the enforcement of this rule so far as possible, and calls attention to the importance of making permanent and efficient grounds. The committee recommends as the best ground a solid connection to underground metallic piping systems, making these connections at each service entrance or at other places where the piping can be reached and the connections periodically inspected.

Report of the Committee on Electrical Apparatus.

Turbo-Generators—Manufacturers now indicate their ability to construct high-voltage generators of large capacities without employing auto-transformers; 25,000-kw. generators are now standardized by American manufacturers.

Reactances—A table of important installations of current limiting reactances is submitted, and a discussion on desirable amounts of reactance in various situations is included.

Speed of Rotative Apparatus—Examples are given of recent apparatus constructed to operate at high speeds.

Direct-Coupled Exciters—Two methods of applying direct-coupled exciters to generating units are given.

Rotary Converters—Reference is made to increase in capacity of individual units of all classes of converters, and the material improvements in 60-cycle rotary converters.

Motor Converters—Attention is directed to the commercial application of a comparatively new form of converting apparatus.

Transformer Connections—Cross-reference is made to Report of Transmission Committee on desirable methods of connecting transforming apparatus for all purposes.

Synchronous Condensers—Standard applications of condensers for line regulation and power-factor correction are recited.

Insulation and Rheostats—Improvements in the construction of these two features of electrical apparatus are discussed.

Brushes—Authoritative data regarding the use, care and life of various types of brushes are given.

Outdoor Substations—The advantages and disadvantages of such construction are shown.

Oil-Switches—A new type of oil-switch is described and reference made to improvements in existing types.

Feeder Regulators—Increase in efficiency appears to be the principal advance in this apparatus. A modification of the induction regulator is now available for outdoor service.

Relays—A new form of reverse-current relay is described.

Rectifiers—Improved life of rectifier tubes is noted and a new development of one manufacturer's apparatus is described.

Electrolytic Lightning Arresters—Changes in design and improvements in operation are recited.

High-Potential Testing Apparatus—A technical discussion of the merits of the several arrangements for testing apparatus for use in central station systems is submitted.

Latest Developments in the Flame Carbon Arc Lamp.

This paper deals with some considerations in the design of flame carbon arc lamps from the point of view of the operating and central station man. Attention is mainly directed to features of mechanical and electrical designs.

The mechanical considerations are divided into a summary of points in the stationary parts of the mechanism under the heading of "Statics," while the considerations fundamental in the design of the moving parts of the mechanism are considered under the heading of "Dynamics."

A brief consideration is given to the design of lamp parts and cases to secure the minimum amount of deterioration at a minimum cost. Some attention is also given to indicating how friction may be very largely eliminated in the regulation of a flame carbon arc lamp, and the maintenance and attention kept at a minimum.

Under the heading of "Electrical Design" some of the requirements for good operation are noted and an explanation given of the manner in which these requirements may be met.

The paper is illustrated by views and sketches of various lamp mechanisms and a number of curves analyzing arc lamp performance.

Report of the Lamp Committee.

The work of the committee has been confined largely to publishing in the Association Bulletin articles on the incandescent lamp situation. The committee has felt that this method of furnishing information month by month is of value to the member companies. A list of the articles is given and they are reproduced in full as an appendix.

Under "Lamp Sales" is shown the total output of incandescent lamps for domestic use, indicating the increase in percentage each year since 1907. The total sales for 1912 increased 6 per cent over 1911, the gem and mazda types representing about 75 per cent of the total. The sale of the carbon lamp is rapidly decreasing, being less than 50 per cent of the preceding year, and conditions indicate the rapid substitution of the metallized and mazda lamps for the carbon.

By reference to the table and curve forming a part of the report the general trend in this direction, as well as other detail, will be apparent.

Under "Development" the report undertakes to show the progress made by manufacturers throughout the year, this has been very rapid, improving as they have the quality of the tungsten filament lamps. These improvements are set forth in some detail. As to prices, the tendency is continually downward.

The development throughout the country in the electric sign business has been very marked, as set forth.

The new types of lamps standardized throughout are listed in detail.

The trade name "mazda" has now been adopted generally by American manufacturers for the tungsten filament lamp. The popularity of the lamp under this trade mark is being rapidly furthered through a liberal policy in its introduction on the part of central station companies and wide publicity given by the manufacturers.

Certain suggestions and recommendations are included within the report.

Report of the Committee on Advertising.

Definite and specific recommendations are given to member companies in towns of less than 100,000 population, on why, when, where and how they should advertise. The paper has been compiled after making careful and personal investigations among the smaller central stations in all parts of the country. It maintains only such advertising campaigns as have proved successful, taking up in succession the selection of an advertising man; the making of the advertising appropriation; the mediums of advertising, under which are discussed the relative values of different newspapers for the advertising of different articles and services; the use of electric signs; the use of the mails, window displays, shows, demonstrations and fairs; theater program and scheme advertising; billboards and moving-picture screens.

The report also discusses in detail "copy" to be used for seasonable advertising, and gives outlines of several campaigns, including a house-wiring campaign, the preparation of mailing lists, etc. It further includes a discussion of co-operative electrical advertising, house organs, and the value of Commercial Section literature to the individual advertising of any member company. The paper is a recommendation for the consideration of advertising and selling as seriously as engineering and operation, in the belief that they are quite as important to the profitable operation of a central station.

Report of Committee on Steam Heating.

1. General discussion of the elements which affect the profitableness of central steam-heating plants.

2. Data on the amount of steam required for restaurants and technical purposes.

3. How to popularize the steam-heating business.

4. Hot water versus steam for heating.

5. Additional suggestions on rates for steam service.

6. Discussion of the availability of exhaust from oil and gas engines for heating buildings. The amount

of heat to be secured about 5 per cent of that from the ordinary simple engine.

7. Study of 12 typical curves, showing the relation between the heating load and the electrical load in ordinary commercial buildings. The utilization of exhaust for heating constitutes a small economy, as compared with the total cost of operating the plant. Small economy secured by using exhaust steam for heating can often be disregarded in order to secure greater economy by the use of large condensing power stations supplemented by independent steam-heating plants for heating limited sections of the commercial district.

Report of the Committee on Electrical Merchandising

This report presents a policy and some methods which, it is believed, may be advantageously utilized in the merchandising of electrical appliances.

It emphasizes the importance of placing this branch of our business on a merchandising basis and strongly advises that appliances be sold at prices which will produce a profit over all costs. It indicates items which should be included in the cost of doing an appliance business and reports the percentage of overhead charges found in the merchandising of appliances by department stores, contractors, supply houses and central stations.

It makes definite recommendations concerning the sale of appliances on installments and the issuing of appliances on trial. It describes some of the successful plans in use by central stations for increasing the sale of appliances.

It touches lightly on the subjects of appliance advertising, repairs and delivery.

A section of the report is devoted to appliance accounting, in which is recommended a simple system of appliance accounting and auditing.

Report of the Committee on Electricity on the Farm.

Practically nothing has been accomplished in real extension of electric lines to the rural districts, largely because of the low density of business to be secured, and because of a lack of faith due to extravagant trade literature, combined with the characteristically small dimensions of the eastern farm. The committee believes that the intensive nature of agriculture necessary in the East, combined with the possibilities of expensive but sufficiently good distribution systems, makes possible a very attractive seasonally off-peak business, especially for the smaller companies where the peripheral zone is large in proportion to that of the metropolitan organizations.

Individual farm applications must of necessity be expensive and rugged, and machines capable of adaptation to a diversity of uses must be kept down to first cost.

Technical efficiency of farm installations must be secondary to convenience, ruggedness, and low cost. Equitable preferential power rates are important, but are secondary to installation expense.

The problem for each individual central station company is unique, must be solved by the company itself, and will require initial expense without immediate return, as did the development of the motor vehicle and industrial power business in the cities. The committee recommends a special man to study and prosecute the farm problem, and believes that halfhearted effort will be money thrown away, while vigorous effort combined with a proper advertising program will produce large results.

Mechanical Office Appliances, Their Uses and Economies.

The paper relates to the operation and uses of many kinds of mechanical devices for office use. The modes of operation and the special advantages of different types of machines and their adaptability to various classes of work are discussed. Economies effected as shown by actual continuous use or by special tests are well brought out. The historical sketch of the principal devices and the relation of one type to another are of great interest and make good reading.

Accounting School and Education of Employes.

Accounting work in the electric lighting industry is increasing in importance, the tendency towards state regulating commissions contributing largely thereto. The rapid growth of the industry into large organizations makes it difficult to depend on experience for a satisfactory accounting education, as the work of each individual is necessarily limited in scope. The public schools do not furnish graduates with satisfactory qualifications and a college training is beyond the reach of most. A course of evening instruction in general accounting, with written examinations to direct serious attention and show results, supplemented by lectures on departmental work and the object and value of accounting to a company was provided by the New York Edison Company. It was demonstrated that such a course was needed and it has also served to direct the attention of the students to the educational possibilities in accounting, to useful text-books and proper courses of study.

Method of Keeping Prepaid and Accrued Accounts.

Many changes have been made in the methods of accounting in central station companies. The keeping of Prepaid and Accrued accounts accurately and conscientiously enables an Auditor to say that the monthly balance sheet reveals actual conditions. Examples of how financial management is aided by the accruing of liabilities. The separation and clear establishment of Prepaid and Accrued accounts relating particularly to taxes is shown. Samples are given of cards for taxing data and special journal forms for taxes. An explanation of forms and examples is worked out to show the method of arriving at the various fiscal year dates and the Prepaid and Accrued amounts. Posting to ledgers is done directly from the combination schedule and journal.

Prepaid insurance premiums should be spread over the period from commencement to expiration of the risk. A check is made on the amounts and dates of bills shown on the Insurance Report, also on the classification of bills. A plan is suggested for divisional accounting, where separate profit and loss statements for subsidiary corporations are desired. Forms are shown that can be used for insurance, bond interest, rentals and income on investments and the suggestion made that an index to the various journals can be used to good advantage in posting.

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POWER AND GAS

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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Electricity and The Law

The electric companies have been harnessed by the law as they in turn have harnessed electricity. The law as a harness has been oddly constructed. The collar has been unevenly padded so that parts of the shoulder have borne most of the burden and become sore; important buckles have been left out and all straps have not been sewed together. The horse has at times become restless, sometimes due to intolerance of restraint and sometimes to the misfit of the harness. Years ago this illustration was used by a noted writer on railroad legislation. Today it is equally applicable to other public service corporations. Our laws are full of inconsistencies and anomalies, spasmodic expressions of legislative impulses and futile attempts of administrative bungles.

The Power of Public Opinion

This journal has published many articles upon power; the power of electricity, of steam, of water, of gas and of air, but their effectiveness pales into insignificance if the development is not endorsed by the power of public opinion. Throughout the course of all history the real "power behind the throne" has been public opinion. Every government that has run counter to its trend has been overthrown, but the leader who trains his aeroplane to its dictates is carried to the highest pinnacles of success.

One ampere of electric current is of little avail without the volt that gives to it the power of the watt. One molecule of gas is inert until dissociated by the electric spark. One cubic foot of steam without pressure can do little work. A single drop of water on the ground is a weak thing, yet united with multitudes of its kind, and given the advantage of a difference in elevation it can sweep aside everything in its path. Thus it is with public opinion—given motion and number it is irresistible. These qualities are imparted by the gradual realization of wrongs, and are liberated by sudden sense of indignity. The machinations of lawyers and politicians can no more stem the flood than can the utmost contrivance of the engineer stop the force of a broken dam.

All power without proper guidance vents itself in destruction. If led through proper channels it is capable of beneficial utilization. Public opinion is guided largely by the great minds in its midst who sway it as they will, until some stronger, and perhaps better, influence attracts it to a new path. For the opinions of even the best of men may be wrong and require but the pointing of the right to be changed.

Today certain strangers who do not appreciate the needs of the West are fostering a sentiment of forest and water hoarding under mistaken ideas that they are thus conserving natural resources. In judicious moderation conservation is greatly needed, but when it will retard the industrial development of the country, leave undeveloped its latent resources, the people dwelling in those communities should suggest that their law makers conserve conservatively. It may take time for this sentiment to grow, but the power of public opinion will finally make itself felt.

The Mathematics of Valuation

In this day of commission regulation of public service companies the business of evaluating properties is becoming one of the duties which the consulting engineer is most frequently called upon to supervise. The details are purely routine, a summation of unit values which can be performed by assistants, a process of integration. But in the determination of the differentials, the elements of value, great skill is necessary.

Appraisers seldom agree as to the value of a public service plant. This is not because of individual bias, but is due to the lack of a uniform basis of valuation. Recently it has become customary to calculate rates for public utilities and to levy taxes on the companies furnishing them upon the estimated worth of the property. This estimate is often made by an arbiter, an engineer whose wide experience in designing, installing and operating such plants has qualified him to act in this capacity. It if were possible to assemble and co-ordinate the experience of a number of such arbiters, we would have the foundation upon which to build a new science, that of appraising.

Analysis shows that the value of any business is dual—the corporeal and the incorporeal. In bookkeeping, these are written as "furniture and fixtures" and "good will." In a public utility plant they are represented by the physical value and the franchise and going values. The first is tangible and readily calculated from the cost of replacing a similar plant, less the depreciation. The last two, being intangible, have been the bone of bitter contention.

It is frequently argued that a franchise, being a license gratuitously granted by the people, should not be capitalized by a corporation because the increased cost of service compels the people to pay the fixed charges on what was formerly their own property. But as the corporation pays taxes on its franchise, it feels justified in calling it an asset. The investment is made "not in the franchise, but under the franchise, and in the faith thereof." The courts have repeatedly recognized the franchise as property whose value depends upon its earning power. An average of many franchise valuations has been estimated by Henry Floy to be about one-third of the actual replacement value of the corporation's assets.

Finally, there is the going value, which is represented by an established or operating business, as distinguished from one that is merely ready for business. Commission rulings are almost unanimous in recommending this element of the problem and its correct determination is of the most vital import.

In the past the tendency has been toward an arbitrary and artificial standard for these several factors. Such empirical rules are typical of all incomplete sciences. The slightest error in a primary determination throws out all later computations and invalidates the final summation. A most excellent remedy has been recently suggested by Mr. H. F. Stimpson in the Bulletin of the Efficiency Society.

Energy is a property common to all service and commodities supplied by public utility companies. By the application of energy to material the latter is transported and transformed in such a manner as to be fit for the use of man, when it becomes a commodity. As all types of energy spring from a common origin, the sun, it may not be unreasonable to infer that their several differences are merely those of volume and intensity. Mr. Stimpson further suggests that the discovery of such a common denominator, together with the duty of certifying to the resultant measurements should be entrusted to a Federal commission, just as the duty of coining money is so entrusted.

Newspaper Jargon

Electricity is now so widely used that its technical terms, hitherto sacred to the scientist, are becoming an integral part of our common speech, especially through the medium of the daily press. Unfortunately, the average newspaper man knows but little about the electric power that takes him to his work, brings him his news, lights his office, operates his linotype and prints his paper. The vagueness of his writings reflects and transmits his ignorance to his readers, who thus unconsciously acquire much misinformation.

How often do we read of "an electric current of ten thousand volts"! It would be just as sensible to speak of water of one hundred pounds, heat quantity of one hundred degrees or money of six per cent when we intend to convey the idea of amount. The correct words denoting quantity which should be used in these connections are an ampere of electricity, a quart or a cubic foot of water, a British thermal unit or a caloric of heat and a dollar or a cent of money. Each of these quantities has no energy or can do no work, which is merely energy applied to a particular purpose until it is moved by some force, such as the voltage of electricity, the heat of water, the temperature of steam or the interest of money.

Energy is an eternal Proteus, indestructible, yet ever assuming new forms. The chemical energy in the cell of a battery is converted to electrical energy, which, in turn, becomes thermal, mechanical or radiant, at our will; the radiant energy in light is transformed to chemical energy in the photographic plate, thermal energy in the conservatory, mechanical energy in the radiometer and electrical energy by indirect means. It is not, however, until energy or work is performed for a definite time that it becomes measurable as power. One ampere under a pressure of one volt for one hour gives the watthour; ten cubic feet per second under a head of ninety feet gives about one hundred horsepower, which is also approximately the power necessary to heat one pound of water seventy degrees Fahrenheit in one second; one dollar at five per cent interest compounded semi-annually has the power of two dollars after fourteen years. Many other examples can be cited, but we believe that these clearly demonstrate the difference between an ampere, a volt, a watt and a watt-hour, or in other words the distinction between a quantity, a force, its energy and its power.

It is argued that common acceptance of a word's definition constitutes sufficient evidence as to its correctness, but this criterion should not be applied to technical words of recognized meaning which may find place in colloquial English. Anyone guilty of loosely using such definite terms not only subjects himself to well deserved ridicule, but also displays his ignorance of a matter upon which he is dependent for many modern conveniences.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

H. C. Carter of Los Angeles is spending a few days in San Francisco.

Rudolph W. Van Norden has been elected a Fellow in the American Institute of Electrical Engineers.

G. Sherman, stores manager of the Western Electric Company spent a week in Seattle recently.

H. B. Bainard, sales manager of the Western States Electric Company at Seattle, is visiting in San Francisco.

John Coffee Hayes, President of the Mt. Whitney Light & Power Company, of Visalia, was in San Francisco this week.

F. J. H. Price, manager of the vacuum cleaning department of the Sturtevant Company of Boston, is a visitor to San Francisco.

W. W. S. Butler of Stockton has left for an extended trip through the East prior to taking up the electrical field in San Francisco.

B. F. Foss, secretary of the Sturtevant Company, Boston, is in San Francisco, and expects to spend the next three months in California and Pacific Coast territory.

H. B. Keith, formerly engineer in charge of the Nisqually power project, Tacoma, Wash., is now connected with the Puget Sound Iron & Steel Works, in that city.

L. F. Blume, transformer engineering department, General Electric Company, Pittsfield, Mass., was in Seattle recently and will visit transformer installations along the Pacific Coast.

A. W. Woodville, manager detail and supply divisions, in the Seattle office of the Westinghouse Electric & Manufacturing Company, is spending a two-weeks' vacation at Long Beach, California.

E. M. Cutting, manager of the Edison Storage Battery Supply Company, of San Francisco, Cal., has recently completed a trip through Oregon, Washington, Idaho, Montana, Utah and Nevada.

Frank Du Frane, telephone specialist of the Western Electric Company, delivered an address before the Oakland Electric Development League last week on various types of interphones. Some forty members of the League were present.

H. S. Clark, respresentative of Westinghouse-Church-Kerr Company at San Francisco, recently returned from an extended trip through the British Northwest, reports the commencement of repair work at Vancouver, B. C., for the British Columbia Electric Railway System.

Floyd Averill, general manager of the Forbes Supply Company of Portland and Seattle, with his family, is spending a few days in San Francisco on his return from Chicago. Mr. Averill has been attending the convention of National Electrical Jobbers as delegate from the Pacific Coast.

Bert L. Cameron, popular member of the electrical field and for many years connected with the Pacific States Electric Company, was married during the week. The charming bride, Mrs. Gertrude Crowe, was private secretary and treasurer of the same firm. The newly-weds expect to spend several weeks in Southern California.

William H. Spindler, formerly in charge of the electrical department of Rhodes Brothers department store, Tacoma, Wash., and **Clarence A. Richards,** formerly with the Kendrick Electric Company in that city, have formed the Spindler-Richards Electric Appliance Company, with headquarters at 611 Fidelity building, where offices and display rooms will be maintained.

OBITUARY.

Charles S. Potter, proprietor of the Potter Electric Company of Portland, Oregon, died May 27th in St. Vincent's hospital as the result of a blow received on the forehead while cranking his auto Friday, May 23d.

Potter did not realize the seriousness of the injury and continued working, but on the 26th he was forced to his bed. He died a few hours later from a fractured skull. He was 44 years of age and a member of the Ancient Order of United Workmen and Artisans, A. O. U. W., and the National Electrical Contractors' Association. He was highly thought of among his friends and had earned the love and respect of all with whom he came in contact. He is survived by a widow and four children.

MEETING NOTICES.

Jobbers at Del Monte.

The Pacific Coast Jobbers' quarterly meeting will be held at Del Monte from the 4th to 7th of this week.

Oregon Technical Club.

Prof. E. H. McCallister of the University of Oregon, addressed the Oregon Technical Club at the regular luncheon on Monday noon, May 26th. His subject was the "Public Road Work now being done in California."

Mr. L. B. Cramer was chairman of the day, as Mr. H. S. Wells of the Pacific Light & Power Company had been called out of the city on business.

Electrical Development and Jovian League.

Among the many interesting and entertaining speakers who have addressed the League, no one has probably been enjoyed or his words appreciated more deeply than those from Dr. Hartland Law at Tuesday's meeting this week. Dr. Law took for his subject "Salesmanship," dwelling at length upon two rather unusual phases—those of control or mastery of the mind and sensativeness and revealing a most thorough and detailed study of his subject. A Nominating Committee, consisting of Messrs. Kinney, Wiggin and DeRemer, was appointed to make a report at next meeting of nominations for officers for ensuing year.

Pacific Coast Convention of A. I. E. E.

We are able to give further details of the plans for the Pacific Coast Convention of the American Institute of Electrical Engineers to be held in Vancouver, B. C., September 9-11, 1913. The personnel of the whole convention committee representing the Pacific Coast Sections, as appointed by President Mershon, is as follows:

Messrs. R. F. Hayward, chairman, Vancouver, B. C.; E. M. Breed, secretary, Vancouver, B. C.; J. R. Read, Vancouver, B. C.; L. C. Robinson, Vancouver, B. C.; A. C. Routh, Vancouver, B. C.; F. D. Nims, Vancouver, B. C.; E. R. Northmore, Los Angeles, Cal.; J. E. Macdonald, Los Angeles, Cal.; G. R. Murphy, San Francisco, Cal.; A. H. Halloran, San Francisco, Cal.; H. R. Wakeman Portland, Ore.; J. B. Fisken, Spokane, Wash.; J. B. Ingersoll, Spokane, Wash.; C. F. Terrell, Seattle, Wash.; M. T. Crawford, Seattle, Wash.

Sub-committees to take charge of the local work of preparing for the convention have been appointed by Chairman Nims of the Vancouver Section, as follows:

General Committee: Messrs. R. F. Hayward, chairman; E. M. Breed, secretary; F. D. Nims, D. P. Roberts, and J. R. Read.

Papers: Messrs. F. D. Nims, chairman; D. P. Roberts and W. W. Fraser.

Transportation: Messrs. E. M. Breed, chairman; J. R. Read, J. Montgomery, E. R. Pease and H. N. Keifer.

Entertainment and Reception: Messrs. L. G. Robinson, chairman; R. H. Sperling, J. Shand, W. V. Hunt, G. R. Wright, W. J. Lister and C. M. Beebe.

Finance: William McNeil.

The Papers Committee has tentatively arranged a program of seven papers, including one paper to be presented in the evening as an illustrated lecture, with the ladies invited to attend. It is proposed to present only one paper at each session, giving opportunity for far more comprehensive discussion on each paper.

Following the regular business of the convention, which will end on Thursday, September 11, two interesting trips are being arranged for those who are able to prolong their visit through Friday and Saturday—a trip to the turbine-driven hydroelectric development of the Western Canada Power Company at Stave Falls, and an excursion to the impulse-wheel-driven hydroelectric plants of the Vancouver Power Company at Lake Buntzen.

Los Angeles Jovian League.

The Los Angeles Jovians took in 74 new members at their banquet and rejuvenation, which was held on May 22nd at the Union League Club, Los Angeles, Cal. The banquet was free to members and visitors and the total attendance was 111. Ira J. Francis was toastmaster and T. E. Burger, J. C. Rendlu, A. E. Morphy, Geo. A. Damon and S. J. Kuse were speakers. The following menu was served:

MENU

FRUIT COCKTAIL
Chemically Pure

CAVIAR CANAPE
With the Q silent

CELERY
Not obligatory

RIPE OLIVES
Mussed up Plums

CONSOMME PRINCESS
"O Piffle!"

STRIPED BASS
For the mentally deficient

TARTAR SAUCE
Always

SWEETBREAD PATTIES A LA KING
and Queen, Jack, Ten and Nine
(Can't beat 'em unless you cheat)

ROMAN PUNCH
Knockout variety

FILLET OF BEEF AND TRUFFLE SAUCE
Real meat—Small wonder that it costs to live

SPARKLING BURGUNDY
Women and Song reserved for later date

FRENCH PEAS
Inevitable

DUCHESS POTATOES
Garden variety

CELERY MAYONNAISE
Left over from Sunday

FRENCH PASTRY
Galvanized
Can also be furnished Sherardized

CAMEMBERT CHEESE
Diabolical

DEMI TASSE
Thank God it's over
SELAH

Oregon Society of Engineers.

The following Code of Ethics is being considered for adoption by the Oregon Society of Engineers, and also by the Pacific Northwest Society of Engineers of Seattle:

1. Engineers should be of sterling honesty and moral integrity. Their success and the standing of the profession depend upon their thoroughness, industry, business talent and upright character. They cannot honorably enter into such competition as that which may exist among business men.

2. They should encourage sound engineering learning, by training in scientific schools, by individual study and reading thereafter, and by actual work.

3. Their clients have a right to expect that the portion of business entrusted to them will receive careful investigation and intelligent treatment. Any information which the engineer has derived from such investigation, and which is peculiar to that business is to be considered confidential.

4. In their professional relations engineers should be governed by strict honor and courtesy. Their conduct toward each other should be such that it will secure mutual confidence and good will.

They should not seek to divert to themselves the work or clients of other engineers.

It is the privilege of a client to transfer his work from one engineer to another; but before the change is made there should be a complete understanding between the engineer in charge and the engineer to whom the work is transferred, to avoid offense.

Communications are to be carried on between responsible heads, and not by unauthorized subordinates.

One engineer should not attempt to secure the service of an assistant or employee of another engineer, without first gaining the permission of such principal.

No assistant or engineer's employer should contract his services to another engineer without first consulting his principal.

An engineer should not hinder the advancement of an assistant, but should give him any aid and encouragement possible.

Criticism of another's work is to be broad and unprejudiced. The whole profession is affected by the success or failure of any member.

The relations between principals and their assistants should be those of frankness and mutual helpfulness.

5. Engineers should be willing to assume their proper share of public work, and to render all assistance possible for the general good of the community.

6. An engineer should not attempt work with which he is unfamiliar or inexperienced. In cases of doubt, consultations should be held with other engineers having broader experience.

One engineer should not use language that will impair confidence in another engineer.

7. Fees are to be based on local conditions, and to represent the customary values. One engineer should not seek to undercut others.

8. As far as possible, engineers should not be interested in any business that will prejudice their opinions as applied to their work.

They should not receive commission for materials entering into the work of which they have charge.

They should avoid any unprofessional advertising or appearance of commercialism, but should give other engineers the avantage of the record and publication, wherever desirable, of any unusual or interesting features of their practice.

9. Their attitude toward contractors should be one of helpfulness and tactfulness, combined with firm and just criticism.

An intimate relation should exist between the various branches of engineering.

ELECTRICAL MEN GO IN FOR BASEBALL.

The Portland Coast Leaguers could well take some pointers from the Pacific States Electric Company of the Jobbers' League. With a score of 10 to 0 against them in a game with the Pacific Light & Power team last week, at Sellwood, the Pacific States boys pounded in nine runs in the fourth inning and continued hitting the ball to the close, winning 24 to 12. The batteries were: Pacific States, Hinkley, Brandenberg and Bremmer; Pacific Light & Power, Fox and Good.

THE TRIP OF THE GOLDEN POPPY.

BY A. H. HALLORAN.

Of the several special trains to the N. E. L. A. convention at Chicago, that of the Golden Poppy from San Francisco is of peculiar interest to the Pacific Coast. This train left San Francisco on May 27th as a second section of the Pacific Limited, with a congenial crowd of thirty-eight electrical men and their families, two joining the party at Reno and one at Ogden.

The first few hours were spent in renewing old acquaintances and making new ones, which will certainly prove lasting as a result of the good-fellowship among all enjoying the trip. At Sacramento the local Jovians, headed by Statesman C. V. Schneider, gave the party a gilt-edge welcome, supplemented by magnificent boxes of magnolias for the ladies. This farewell was greatly appreciated, and Sacramento will always have a warm spot in the hearts of all who enjoyed their hospitality.

The trip over the high Sierras and across Nevada was uneventful, except for the appearance of a gigantic elephant near the summit. This beast of burden refused all refreshment offered, except the candy, which was abundantly supplied for the ladies by the Wagner Electric Company, who also furnished cigars and cigarettes in great plenty for the men throughout the entire trip. The Westinghouse Electric & Manufacturing Company also presented each passenger with a leather note-book, and directions for resuscitation, while Pierson, Roeding & Co. distributed whist scores and poker chips, both of which were in great demand, and incidentally put to their proper uses. Mr. T. E. Bibbins of the General Electric Company presented a beautiful bouquet of flowers to each lady each morning, having also provided a General Electric emblem pin to secure them, and consequently was one of the most popular men present. He also distributed decks of playing cards.

Friday morning the "Journal of Electrocution" was on the breakfast table. This clever publication was ably edited by Mr. Tom Collins, who justly earned the reputation as the wit of the party. Many copies of this unique publication were mailed to friends at home, as was also the train directory, which was presented by the Wagner Electric Company.

At Ogden the enthusiastic members of the Utah Electric Club were on hand to wish the travelers bon voyage. Most of the members came up from Salt Lake City, and the party were unanimous in expressing their appreciation of this courtesy, and their regret at not being able to enjoy the program, which had to be abandoned at Salt Lake because of lack of time.

During the afternoon Mr. Morphy of the Southern California Edison Company earned his spurs as a peddler, and added more than his share in promoting the gaiety of the party. By this time also the double quartet was in full voice, and supplemented the entertainment provided by the phonograph contributed by the Eilers Music Company. This phonograph was transferred to each new observation car which the management of the several railroads saw fit to take off and put on to the train at division points. In fact, the changes became so frequent that an indignation meeting was held on Friday evening, which resulted in creating great unanimity of spirit, but was otherwise fruitless.

The oxometer was pressed into service to test the hot air ability of both peddlers and central station men on Friday night, Mr. Pierce being given the highest rating as the Best Spieler, and receiving the "gentlemen's prize" presented by G. I. Kinney of Fort Wayne Electric Company.

Saturday's big event was a card tournament for handsome electric heating devices, conducted by the General Eltctric Company, Holabird-Reynolds Company and Westinghouse Electric & Manufacturing Company. In the bridge game the highest score was made by George Campbell, Miss Metcalfe being a close second, and Mrs. Campbell receiving the consolation prize. In "500" Carl Heise was high man, Miss Strong of the Southern California Edison Company second and Halloran low man.

Saturday night's entertainment was furnished by the irrepressible Morphy, ably abetted by Tom Collins. It is sufficient to add that they probably enjoyed it more than did their non-sleeping victims.

The crowd reached Chicago by noon Sunday, ready for the strenuous activities of the convention week. It is to the credit of the California delegation that they represent the greatest passenger-mileage in attendance, the figure being slightly above 100,000.

NEW SECRETARY OF PACIFIC COAST ELECTRIC RAILWAY ASSOCIATION.

Mr. H. C. Hazzard has accepted the position of permanent Secretary of the Pacific Coast Electric Railway Association, which was organized on April 1st last, and includes the various electric lines in the States of California, Oregon and Washington. He will assume his duties on July 1st, and will be located in Portland, Oregon.

Mr. Hazzard is a Californian, but has resided in the East for the past ten years. He was connected with the first Railroad Commission appointed by Governor Hughes of New York, and recently severed his Eastern connections to be identified with the California State Railroad Commission, from which he is now resigning.

TRADE NOTES.

Kilbourne & Clark Manufacturing Company, Seattle, is filling an order for radio telegraph rotary converters, recently received from England.

Charles C. Moore & Company are installing a 150 horsepower Stirling boiler in the Merchants' Exchange Building plant at San Francisco, Cal.

J. J. Agutter & Company, Seattle, Wash., have the electrical installations well under way in the Elks' Club building at Fourth avenue and Spring street.

The Puget Sound Traction, Light & Power Company is getting ready to extend its tracks on Spokane avenue at the Ferry landing, a distance of approximately 1000 ft.

NePage, McKenney & Company of Seattle, Wash., have the contract for the complete electric lighting, power, telephones and fixtures in the McBride opera house at Victoria, B. C., amounting to $15,000.

Evans-Dickson Company, Tacoma, Wash., have been awarded an additional contract for installing an engine set, rotary converter and switchboards at Fort Casey, Washington, the contract approximating $3000.

The Westinghouse Electric & Manufacturing Company has received an order from the Anaconda Copper Mining Company for 2-1200 h.p., 2400-volt, 3-phase, 60-cycle, 75 r.p.m., synchronous motors for direct connection to cross-compound compressors.

Evans-Dickson Company, Tacoma, Wash., have the contract for electrical installations in the four-story Pacific Brewing & Malting Company building, also similar work for the park board in the Point Defiance unloading station now under construction.

NEW CATALOGUES.

The Sprague Electric Works of the General Electric Company have issued catalogue No. 439, which contains descriptions of the Sprague conduit products.

The Edison Storage Battery Company Orange, N. J., has issued an attractive booklet, describing the Edison Battery, in use for house-lighting plants. The book is illustrated with many views taken from a house equipped with one of the Edison sets, showing the arrangement of lights, heating devices, fans, washing machine and other electrical conveniences.

INDUSTRIAL

WESTON MINIATURE DIRECT-CURRENT INSTRUMENTS.

The Weston Electrical Instrument Company of Newark, N. J., after making many models, has developed a line of miniature instruments of the permanent magnet movable coil type for the measurement of current and voltage, including voltmeters, ammeters, volt-ammeters, special battery testing voltmeters, and milli-ampere meters. Single, double and triple range instruments may be obtained, in various combinations.

Fig. 1.—Portable Voltmeter.

These instruments are carefully made, and are very compact. They weigh less than a pound and may easily be carried in the pocket. The pointer of the portable form is knife-edged to permit close reading. The scale length is 2¾ inches. They are made as carefully and as conscientiously as the highest grade Weston apparatus.

The movable system of these instruments is extremely light, weighing less than 0.2 gram (less than the weight of two common pins). This system is magnetically damped, and comes to rest quickly after the application of current. In fact, not more than about 1/5 second will elapse before the pointer comes to rest in any new position due to changes in current or e.m.f.

Both portable and switchboard types are shielded against external magnetic fields and are practically unaffected by changes in temperature.

Fig. 2.—Miniature Switchboard Meter.

Fig. 1 shows a triple range portable volt-ammeter one-half actual size, the outside dimensions being 4.4 by 4.6 inches. With this instrument any e.m.f. from 150 volts to 0.02 volts and any current from 30 amperes to 0.05 ampere may be measured.

These miniature instruments serve many useful purposes. In high schools and colleges the results obtainable with them are more than equal to class room and laboratory requirements, and their low price permits their extensive introduction, so that each student working in a laboratory may be provided with an instrument.

The miniature switchboard meter shown in Fig. 2 is one-half actual size. The movements in these instruments are practically identical with the portable models, but a pointer with a pear-shaped tip is used to permit readings at a considerable distance. These instruments are all single range and back connected.

Fig. 3.—Battery-Testing Voltmeter.

They are made in numerous ranges from 50 milli-amperes to 30 amperes, and from 50 milli-volts to 150 volts. These instruments are specially useful in all cases where size and weight are important factors, and with the advantage of low first cost, serve excellently in connection with automobile self-starters or headlight batteries, small isolated plants, apparatus for physicians' use in electro-therapeutics, dental work, etc.

Fig. 3 represents a battery testing voltmeter, one-half actual size. These are provided with a steel point at one terminal which is removable, and may be replaced by a regular binding post nut. To the other binding post may be attached a flexible cord with another point supplied with the instrument.

Fig. 4 illustrates switchhoard volt-ammeters designed specially for storage battery charging outfits for automobiles

Fig. 4. Switchboard Voltmeter.

and other small installations where it is necessary or preferable to use one instruments to indicate both volts and amperes. Normally it indicates the charging or discharging current, but when pressure is applied to the contact button the pointer will indicate volts.

NEWS NOTES

INCORPORATIONS.

BOISE, IDAHO.—The St. Anthony Power Company, Ltd., has been incorporated for $250,000 to construct and operate power plants with Ashton as the principal place of business. Officers: A. Whitten, Blackfoot, president; H. C. Graves, Ashton, vice-president; W. L. Robinson, Ashton, treasurer.

ILLUMINATION.

NYSSA, ORE.—The Beaver River Power Company expects to enter this field in the near future.

LOS ANGELES, CAL.—Herbert J. Goudge and Paul Overton, counsel for the Los Angeles Gas & Electric Company, appeared in opposition to the application of the Economic Gas Company, before Commissioner Eshleman for approval of its bond issue. The Economic quite recently issued $930,000 first mortgage 5 per cent bonds, out of a total issue of $1,500,000 and disposed of them at 83.33. The company is now applying to have its action ratified. Counsel for the Los Angeles Gas & Electric Company interposed a formal protest on the ground that the money derived from the bond sale had been used in invading its territory in the city of Los Angeles and paralleling its mains.

LOS ANGELES, CAL.—The city council, at the conclusion of a public hearing denied all protests and sustained the electric light and power rates, as fixed by the board of public utilities, for the fiscal year commencing July 1. This action means that the electric light rate, commencing July 1, will be reduced from 6½c to 6c and the power rate from 6c to 5c, for the first 100 kw. hours consumed in one month. Approximately 74,000 light and power consumers will be benefited by the reduction and these consumers will save about $250,000 a year, according to the estimate of officials of the utilities department. The new rates fixed by the utilities board and approved by the council were recommended by James E. Barker, the board's engineer, who made a thorough investigation of valuations, and is of the opinion that the companies will receive a just and reasonable return on their investments.

TRANSMISSION.

BOISE, IDAHO.—Secretary of Interior Lane has allotted $38,000 from funds now available for construction of the Arrowrock dam, Boise irrigation project, Idaho, for power development.

MARTINEZ, CAL.—The contract for the erection of a reinforced concrete substation and powerhouse on the line of the Great Western Power Company, near Antioch, where the power line spans the San Joaquin River, has been awarded to the Reardon-Crist Construction Company, for $8000.

BOISE, IDAHO.—Reports that will not down are going the rounds locally that W. H. Bancroft, general manager of the Harriman interests in this section, is negotiating for the purchase outright of all the power interests and all the interurban traction interests in this section of Idaho. This deal, which the reports have it are now well underway, includes the Kuhn power interests, the Beaver River Company holdings, all the interests of the Idaho-Oregon Light and Power Company and all the interests of the Idaho Traction Company.

SANTA BARBARA, CAL.—Merging of all the electrical power interests in Santa Barbara, San Luis Obispo and Fresno counties into one corporation is the scheme afoot which seems destined to prove a large factor in this county. Involved in the plan is one to absorb also a number of gas and water corporations, bringing all under the control of one management. It is understood that the Kirckhoff-Balch interests, which are back of the San Joaquin Light & Power Company, are backing this new scheme of consolidation and expansion.

SPOKANE, WASH.—A group of Spokane capitalists have concluded the purchase of the Nixon-Kimmel Company's power plant on the Methow River, just above Pateros, now supplying power and light for Pateros, Bridgeport and Brewster. They have also purchased the power and light distribution system at Okanogan, Wash. These men are now organizing a $300,000 corporation, which will probably be known as the Okanogan Valley Power & Light Company, for the purpose of supplying power and light for the rapidly developing Okanogan district. Eugene Enloe is president of the new corporation; S. E. Gates, vice-president, and W. C. Sivyer, secretary-treasurer. These men are now associated in the Big Bend Light & Power Company which supplies light and power to seven towns in the Big Bend country. They also have the Grangeville Light & Power Company, supplying nine towns in the rapidly developing Grangeville district.

ELY, NEV.—J. P. Martin, district engineer for the Forest Service in company with Supervisor Thompson of the Nevada National Forest. last week visited Cleve Creek to make formal inspection of the stream to report on the application of W. Lackner, of Salt Lake, for permission to utilize the stream for generating electric power. The stream being within the boundaries of the Nevada National forest, it is necessary that permission from the service shall be obtained by anyone desiring to use the water in any way. If the application of Mr. Lackner is approved, he will be permitted to erect a power house at the mouth of the Cleve Creek Canyon and construct a conduit 5000 ft. long with a 450 ft. head to convey the waters of the stream to it; assuming that he also has permission from the State of Nevada to use the water for power purposes. On approval of such applications the service grants a preliminary permit covering a period of one to two years. If the proposed power plant is to really be constructed then the applicant is given a 50 year permit.

TRANSPORTATION.

ASHLAND, ORE.—The Jackson County Court has granted a franchise to S. S. Bullis of New York, to operate interurban trolley lines upon public highways throughout the county. The terms imply that one mile must be built and operated within a year.

SAN DIEGO, CAL.—As soon as the city can establish a satisfactory grade, John D. Spreckels will extend the Ocean Beach Electric car line from a point just beyond Loma Portal through Rossville and La Playa to Fort Rosecrans military reservation.

SACRAMENTO, CAL.—The line of the Central Traction Company will, it is reported, be extended to Consumnes within the next few months. It is understood that when the line has been extended to that point arrangements will be made to build it on to Jackson in Amador county.

LOS ANGELES, CAL.—Because of numerous protests filed with it, the board of public utilities proposes to hold a public hearing on the application of the Pacific Electric Company for a franchise to construct and operate a double

track elevated railway from the rear of its Sixth street depot to San Pedro street, there to connect with the municipal line to be built between Aliso and Ninth streets on San Pedro street.

OAKLAND, CAL.—The resignation of E. A. Heron, president of the traction interests merged in the San Francisco-Oakland Terminal Railways, has been accepted by the reorganized board of directors of the company, and William A. Bissell, traffic manager of the Santa Fe, has been elected president. James K. Moffit, vice-president of the First National Bank of San Francisco, and a member of the trustees operating committee and of the company's directorate, was made vice-president to fill the vacancy caused by Mr. Bissell's advancement to the presidency. W. R. Alberger, vice-president and general manager, will, it is said, retain his position, as will Secretary F. W. Frost.

SAN FRANCISCO, CAL.—The State Supreme Court has removed all legal obstacles to the enforcement of the agreement between the city and the United Railroads for the use of the outer tracks on Market street from Sutter street to the city front, and within 40 days the municipal cars will be operating down Market street from Geary to the Ferry. The United Railroads' Sutter street cars are already running to the Ferry. The contractor for the Geary street tracks and those of the United Railroads on Market, F. Rolando, expects to have the connection established within 30 days. The United Railroads and city must share the expense and maintenance cost of the outer tracks from Sutter and Market to the Ferry. The city must pay to the United Railroads one-half the value of the outer tracks, the value not to exceed $25,000. The Sutter Street railway on Market from Sutter to the Ferry is declared annulled save for those franchise rights extended by the agreement. At midnight of November 14, 1919, the agreement shall become automatically annulled and the United Railroads is then under obligation to sell its share in the outer tracks to the city.

SACRAMENTO, CAL.—As soon as the Colusa branch of the Northern Electric is turned over to the operating department of that railroad, the construction department which is now completing that line, will turn its attention to the lines beween Sacramento and Vallejo, formerly known as the Vallejo and Northern and which will establish, by means of boat service from Vallejo to San Francisco, new electric service between Sacramento and San Francisco. The first work to be done by the construction department of the railroad will be to complete the ten-mile line between Vacaville and Suisun. Six miles of this branch already has been built out of Suisun. When this branch line is completed all energies will be turned toward the completion of the direct line between Vallejo and Sacramento, a distance of about 60 miles. The terminal has been completed at Vallejo and construction work will proceed out of that city toward Suisun through the Cordelia Hills. From Vallejo the main line will make a direct route for Sacramento, a distance of 30 miles. After the main line from Sacramento to Vallejo is finished, it is the announced intention of the company to complete a line from Woodland to Vacaville.

TELEPHONE AND TELEGRAPH.

COLFAX, CAL.—The commission has granted authority to Carl G. Bell and John L. Butler to purchase the telephone exchange of John B. McCleary.

BISBEE, ARIZ.—P. C. Gattins, district manager of the Mountain States Telephone & Telegraph Company, states that the company is getting figures on a number of proposed lines in the northern part of the state. One of the first lines to be increased will be that between Tucson and Benson. This will be the basis for opening up considerable territory to the north.

WATERWORKS.

SANTA CRUZ, CAL.—Preliminary steps were taken at a recent meeting of the city council for the calling of a bond election for the redemption of the waterworks.

KALISPELL, MONT.—The city is contemplating purchasing the water works now owned by the Northern Idaho & Montana Power Company. The council has engaged consulting engineers to estimate the cost of a new water works system and also appraise the value of the existing water works system.

OLYMPIA, WASH.—An ordinance providing for the construction of a water system and issuance of $150,000 bonds in payment was read at the last meeting of the council. Summit Lake in the Black Hills, 12 miles from Olympia, will be the source of supply. The bonds will be payable in blocks from $6000 to $14,000 each year after 1917, running as long as 1932. They will bear 6½ per cent interest. The system will be constructed to discharge 2,500,000 gallons every 24 hours, into a 3,000,000 gallon reservoir. It will be constructed on the W. C. Dobbin donation claim.

SAN JOSE, CAL.—Commissioner Gordon presided at the hearing of the application of the San Jose Water Company for leave to buy certain riparian rights and other water rights from the Pacific Gas & Electric Company and to issue $100,000 of notes, secured by its water system, which supplies Los Gatos. Manager Rylands of the water company explained, in reply to C. P. Cutten's questions, that many years ago his company entered into a contract with a predecessor in interest of the Pacific company to supply it with water for power and that subsequently the Pacific company secured riparian rights on the creek, that was the water company's source of supply. The water company is willing to pay $25,000 for these water rights and the release of this contract. The matter was taken under advisement..

SAN FRANCISCO, CAL.—City Engineer O'Shaughnessy is arranging to proceed with the appraisement for the city which President Bourne of the Spring Valley Water Company insists should be made of the corporation's property. Mayor Rolph says any renewal of purchase negotiations will mean no loss of time, as the new law allowing the city to bring the suggested condemnation suit in a single county will not be effective until 90 days after its approval. The finance committee has put over for a week the proposal of the public utilities committee that $100,000 of water supply bond issue funds be appropriated for the purchase of pipe to be used in extending the Spring Valley's local distributing system. There is now available of such funds only $114,000, and more bonds must be sold before any heavy drain is made upon them. Any appropriation for pipe must be confined to $75,000.

SAN RAFAEL, CAL.—The engineers of the muncipal water district of Southern Marin have filed their report. The engineers find that there are four sources of water supply available. The first is the Bon Tempe system with a reservoir site on the big flat between Liberty and Fairfax. Including main supply pipes this system, it is estimated, would cost $1,751,257. The Alpine gravity system on Lagunitas Creek, would cost $1,998,857. The Alpine pumping system would cost $1,765,857, and the Alpine independent system would cost $1,821,400. The report also states that the development of a water supply on the Russian River is perfectly feasible. The estimated value of the plants of the several water companies now furnishing the supply here is given as follows. Marin Water & Power Company, $896,697; North Coast Water Company, $250,500; Sausalito Municipal Plant, $124,613; Sausalito Land & Ferry Company, $17,423; H. A. Boyle, Tiburon, $3100; American Land & Trust Company (Larkspur), $11,597; Doherty Company, Corte Madera, $8665; Mailliard Estate, Lagunitas, $10,034; E. C. Chapman, Corte Madera, $15,760.

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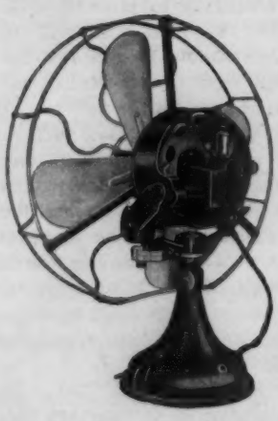

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Replies may be sent in care of the Journal of Electricity, Power and Gas, Rialto Building, San Francisco.

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